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TECHNICAL REPORT S-30
February 1974
Effect of Gear Pattern of Airfield Pavement Performance

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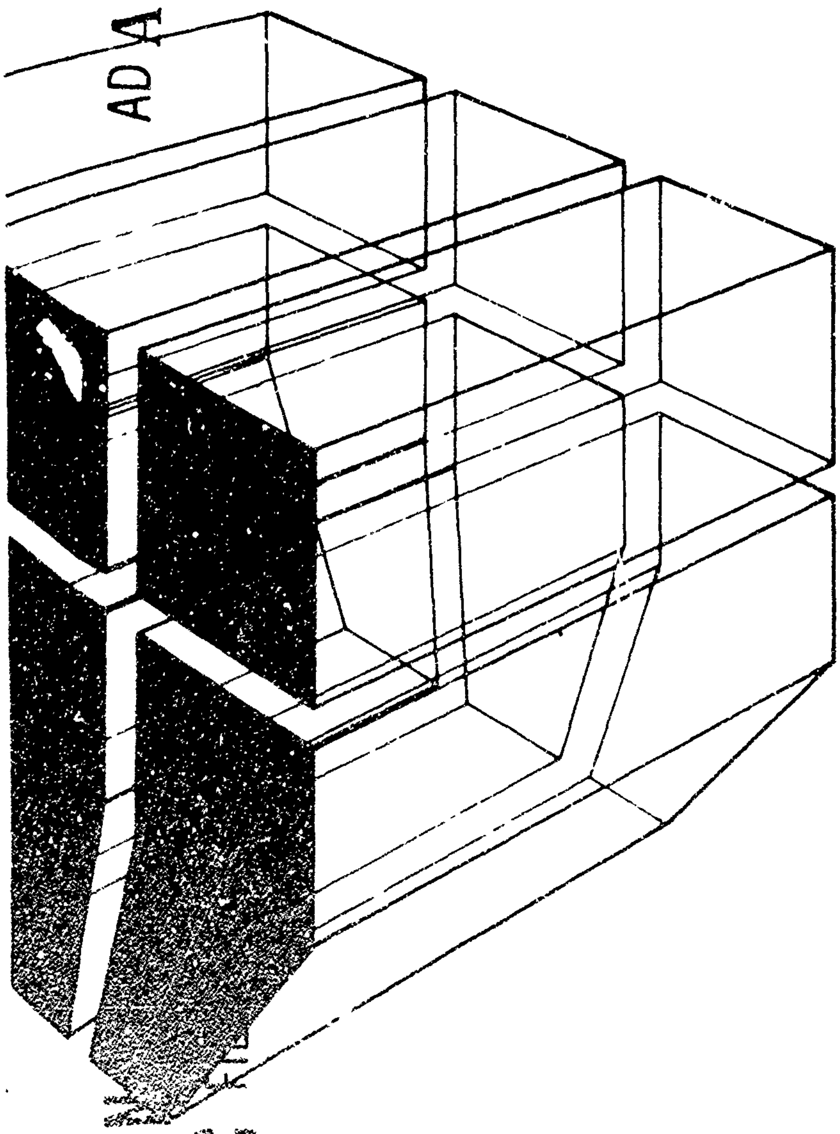
THE EFFECTS OF GEAR PATTERN ON PAVEMENT SYSTEMS PERFORMANCE



by
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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: CERL-TR-S-30 (14)
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER (9)
4. TITLE (and Subtitle): (6) THE EFFECTS OF GEAR PATTERN ON PAVEMENT SYSTEMS PERFORMANCE.
5. TYPE OF REPORT & PERIOD COVERED: FINAL REPORT,
6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): (10) J. L./Rice, J. J./Panak, J. J./Healy
8. CONTRACT OR GRANT NUMBER(s): ~~DACA 23-70-C-0070~~
9. PERFORMING ORGANIZATION NAME AND ADDRESS: CONSTRUCTION ENGINEERING RESEARCH LABORATORY, P.O. Box 4005, Champaign, Illinois 61820
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (16) 4A664717D895-04-003 (17)
11. CONTROLLING OFFICE NAME AND ADDRESS
12. REPORT DATE: (11) Feb[redacted]74
13. NUMBER OF PAGES: 129
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): (12) 126p.
15. SECURITY CLASS (of this report): UNCLASSIFIED
15a. DECLASSIFICATION DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
18. SUPPLEMENTARY NOTES
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

gear pattern
airfield pavement
pavement systems

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the results of a study of the effects of gear pattern on airfield pavement performance. The report presents the methodology required to express aircraft traffic in terms of passes rather than the current coverage concept. The method is capable of considering wheel interaction rather than only surface geometry.

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FOREWORD

This investigation was sponsored by the Office of the Chief of Engineers (OCE), Washington, D.C. as part of RDT&E Program 6.47.17.D, Project 4A664717D895 "Military Construction Systems Development," Task 04 "Military Airfield Facilities," Work Unit 003 "Effect of Gear Pattern of Airfield Pavement Performance," with Mr. A. Muller as Technical Monitor.

The investigation was conducted by the U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, Illinois. CERL personnel actively engaged in the investigation were J. L. Rice and J. J. Healy who assisted in preparation of the report. Appendix A was prepared for CERL by J. J. Panak under Contract No. DACA 23-70-C-[illegible]76.

Dr. L. R. Shaffer is Director of CERL.

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THE EFFECTS OF GEAR PATTERN ON SYSTEMS PERFORMANCE

1 INTRODUCTION

Problem. A major problem in airfield pavement evaluation and design is assessing the damage which will be caused by new landing gear loads and complex geometries. In addition, a need exists to determine the design life and life remaining in an existing airfield pavement. This problem is compounded due to the effects of mixed traffic and the lack of a suitable rationale for handling mixed traffic.

Background. The two new jumbo jet aircraft now in operation, the C-5A and the Boeing 747, may require a new trend in development of future aircraft pavement. Sufficient ground flotation or load distribution in the landing gear design was required for the C-5A so that the aircraft could operate from a medium load pavement as defined in TM 5-824-3.[1] The Federal Aviation Administration (FAA), prior to the introduction of the 747, placed a requirement on aircraft designers which limited the pavement flexural stress to that which was developed by the stretched version of the DC-8 aircraft. If this trend is continued in the future, pavement requirements for new aircraft may level off at some bounding limit. If these requirements do approach a bounding limit, the pavement engineer will no longer have the luxury of designing for the heaviest aircraft and ignoring the lighter traffic because many aircraft types will have nearly the same pavement requirements. As aircraft continue to grow in size and weight, an economic breaking point is certain to be reached where it will be more economical to upgrade the pavements than to provide more flotation on the aircraft. In order to provide the necessary flotation, aircraft designers will probably introduce radically different geometries and varying wheel loads all of which will require a more precise method of analysis.

Scope and Objective. The objective of this study is to identify a technique which will permit OCE to provide an improved method for specifying the relative effects of traffic loads on rigid pavements to reflect variations in gear patterns, with particular emphasis on multiwheel aircraft including the C-5A and 747 aircraft. The scope of this study is limited to provide the necessary methodology to satisfy that objective.

Previous Attempts to Solve. Other investigators[2] have approached this problem in different ways. Attempts have been based on an equivalence in stress developed in the pavement. The relative severity of two landing gear systems is judged by comparing the critical flexural stresses generated in the pavement slab. Fatigue effects are accounted for through the use of Miner's hypothesis which assumes that damage is relative and linearly proportional to the ratio of actual traffic to traffic at failure for each wheel load configuration. The new multiwheel landing gear systems, in addition to developing critical stress, also distort pavements over large areas at stresses below the critical stress. Previous methods have ignored the subcritical stresses and have some limited success because the subcritical stresses were substantially smaller than the critical.

Theoretical Considerations. Pavement response to static loading can be predicted with reasonable accuracy using the Westergaard algorithm. Using the same assumptions, Westergaard, Stelzer and Hudson[3] have developed a finite element representation of a loaded pavement slab which allows a more flexible modeling of boundary conditions. Such a finite element analysis has been adapted to the use of complex gear patterns as a part of this study (Appendix A). It is possible to construct influence lines for a point on the pavement which can be used to approximate the stress, strain, and or deflection history for the point produced by a load at other points on the pavement. The stress history at a point in a rigid pavement which results from the movement of a multiple wheel landing gear system is likely to contain a number of stress excursions of varying magnitude.

Various investigators have had success in describing fatigue failure by performing a weighted summation of the excursions of stress, strain, or deflection which a specimen encounters. The excursions have to be weighted as to severity for obvious reasons. For

[1] *Rigid Pavements for Airfields Other than Army*, TM 5-824-3 (1970).

[2] *A Method for Estimating the Life of Rigid Pavements*, ORDL Technical Report No. 4-23 (1962).

[3] C. F. Stelzer and W. R. Hudson, *A Direct Computer Solution for Plates and Pavement Slabs*, Research Report 56-9 (Center for Highway Research, University of Texas, 1967).

example a specimen may be capable of sustaining a strain excursion of 200 micro inches per in only 10 times but it can sustain 3000 excursions of 50 micro in per in. If a strain cycle relationship expressed as 200 micro inches per inch × 10 cycles = 2000 strain cycles were to be used, as a basis of performance, the pavement could sustain 50 micro inches per inch at 2000 ÷ 50 = 40 cycles instead of the 3000 cycles measured. Obviously a weighting technique must be applied to the magnitude of the excursion. This is accomplished by assuming that damage is proportional to some function of the number of operations. For the purpose of this study a log function has been selected. It should be emphasized however that this relationship requires further study as additional data become available.

2 BASIS OF ANALYSIS

A number of factors must be considered in an analysis of complex loading history. Generally speaking only two response parameters are available from existing analytical procedures used in the evaluation of pavements: deflection and bending moment. The single most important factor to be considered for pavements loaded near the center of the slab is gear configuration, i.e., single wheel, twin tandem, or multi-wheeled landing gears.

The two pavement response parameters, deflection and bending moment, provide a basis for determining the amount or degree of distortion introduced in a pavement by a particular gear loading. From an analysis viewpoint, bending moment is of more value than deflection because a pavement can conceivably be subjected to large deflection with a small bending moment and vice versa. Bending moment can be converted into stresses and strain assuming linearly elastic component behavior. Current design procedures are based on flexural stress considerations which are directly obtained from bending moment utilizing elastic plate bending theory.

Performance data for pavements subjected to various gear configuration loadings are rather difficult to obtain. Several controlled traffic tests have been performed by the Corps of Engineers in past years. These tests are of the test track type where aircraft loading is simulated by a loading apparatus trafficking a series of test slabs in which several parameters are varied such as slab thickness, subgrade strength, etc. These tests have been conducted at low speed and typically the loading apparatus is capable of simulating one main gear of the aircraft. Performance of the test items is assessed in accordance with current Corps of Engineers performance criteria. Three degrees of failure have been established by the Corps of Engineers as follows:

1 *Initial Failure*—That point when a crack develops in a pavement and extends through the entire thickness of the pavement as a result of traffic loading. The crack must be due to an externally applied loading and not to shrinkage or other nontraffic effects.

2 *Shattered Slab*—That point where traffic induced cracking has subdivided the pavement slab into six visible pieces. As with the initial failure criterion, the cracks must be due to externally applied loading and must extend through the full depth of the pavement slab.

3 *Complete Failure*—That point where the pavement slab has been cracked into about 35 pieces, each piece having an area of 15 to 20 square feet. At this point, the pavement would be considered nonoperational due to excessive roughness and the likelihood of debris formation.

Due to the inherent assumptions associated with the available pavement analysis procedures, primary emphasis has been placed on the initial failure condition. The shattered slab and complete failure conditions represent situations too unwieldy for analytical modeling at this time.

Actual in-service pavements are subjected to a mixture of traffic. Air Force bases which are dedicated to bomber wings will experience not only bomber traffic but also support type traffic such as tankers, cargo aircraft, etc. Some data are available on traffic operations at selected Air Force bases. These data should be analyzed to determine probable traffic mixtures for selected Air Force bases.

3 WHEEL LOADING PATTERNS

The footprint produced by a complex landing gear can be examined by either deflection contours or strain contours. The detail of the contour pattern

will depend on the pavement thickness, subgrade modulus, the elastic properties of the concrete pavement slab, wheel loads and spacing, in addition to the slab geometry in relation to the wheel loads.

It is possible therefore to define the cyclic strain or deflection history on a pavement by using the footprint as an influence diagram in which the wheel loading paths relative to a point in the pavement are traced on the contour.

The basis for this technique is outlined as follows A plot of either pavement deflection or strain response in the form of contours can be used to predict pavement response due to traffic loading. Since the concrete and foundation materials are assumed to behave elastically, superposition can be used to determine response histories for each of the traffic lanes The contour plot moves along the pavement coincident with the wheel gear system. Therefore, the deflection or strain history at a point in the pavement can be constructed from the contour plot simply by tracing the location of the point in the pavement on the contour as the wheel gear passes over.

An example of the use of such an approach follows: Figure 1 is a contour plot of deflection for a single wheel loading on a Lockbourne test slab. It represents the deflection history of a test pavement subjected to a 37,000 pound wheel loading resulting from traffic by an A-3 Tournapull with a Model NU scraper. The traffic lines are designated on the contour plot and represent the path followed by each of the loading wheels. These plots were used to develop response histories. The deflection history of the pavement at the transverse joint shown on Figure 1 produced by single wheels traversing each of the traffic lines would then be computed as follows:

Lane 1	Front Wheel	- .023 in.
	Rear Wheel	- .033 in.
Lane 2	Front Wheel	- .007 in.
	Rear Wheel	- .013 in.

Initial failure occurred after 90 operations. The area of the histogram representing the deflection history is

$$.033 \ln 90 + .023 \ln 90 + .007 \ln 90 + .013 \ln 90 = .342$$

The procedure described in the above example was applied to other test pavements subjected to single, twin tandem, and 12-wheel assembly loading. Pertinent physical properties from test items trafficked in the Lockbourne and Multiple Wheel Heavy Gear Load (MWHGL) tests were used in a finite element computer program for pavement analysis developed by Austin Research Engineers, Inc. This program computes both deflection and principle stress or moment at each nodal nt (Appendix A) Thus, a single run of the program rovides a rather complete picture of the response of an entire pavement slab Weighted histogram areas were calculated for the initial crack failure condition. The summation of the weighted area histogram is indicative of the distortion of the slab under load. Histograms were produced for single, twin tandem, and 12-wheel landing gear arrays with 30,000 lb wheel loads. The average values for the weighted areas were .318 for single wheel, .526 for twin tandem and 1.43 for 12-wheel assemblies Using the single wheel loading as a datum, this would indicate that twin tandem assemblies distort the slab 1.66 times as much as single wheel. These values are indicative of the strain relief and reversals occurring between loading wheels.

4 PAVEMENT LOADING HISTOGRAMS

Previous test track data were analyzed in view of the strain-deflection history approach. The current Corps of Engineers design method is based on critical flexural stresses generated at a jointed edge. An attempt to produce strain-deflection histories was based on conditions which exist at a jointed edge. This initial attempt was performed using data collected from the Lockbourne[4] and MWHGL[5] test tracks.

The analysis of data from these tests presented problems due to jointed edge behavior. For design purposes, a jointed edge is assumed to transfer 25 percent of the load across the joint over the design life.[6] The 25 percent load transfer factor was established based on performance data from many experimental and in-service pavements. While the load transfer value is probably valid as an average, some

[4] *Lockbourne No 1 Test Track*, Final Report (U S Army Ohio River Division Laboratories, 1946)

[5] *Multiple Wheel Heavy Gear Load Pavement Tests*, WES-TR-571-17, Vol I-IV (Waterways Experiment Station, 1971)

[6] R L. Hutchinson, *Basis for Rigid Pavement Design for Military Airfields*, Miscellaneous Paper No 5-7 (Waterways Experiment Station, 1966)

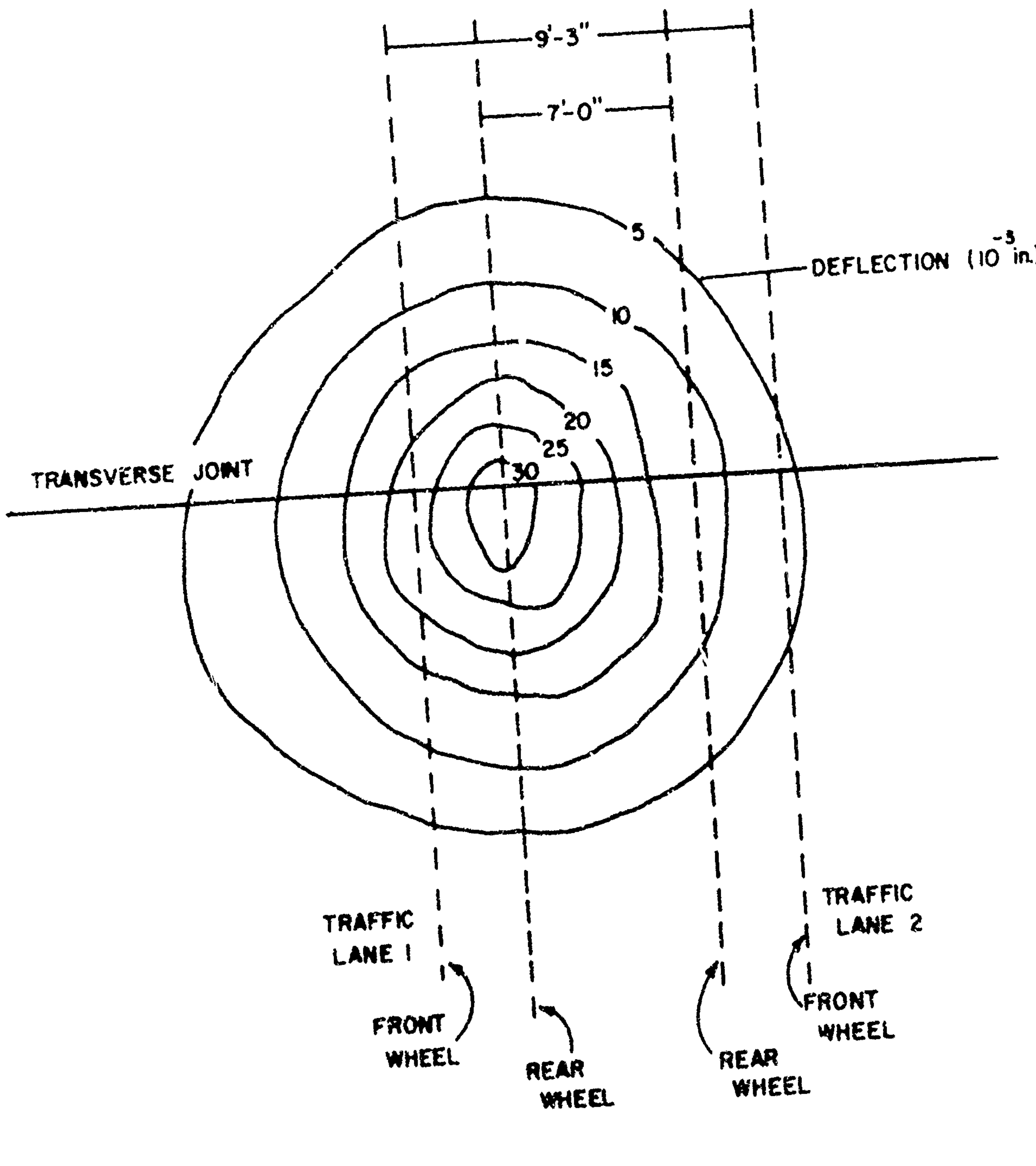

Figure 1. Deflection contours for 87,000 wheel loading Lockbourne test slab.

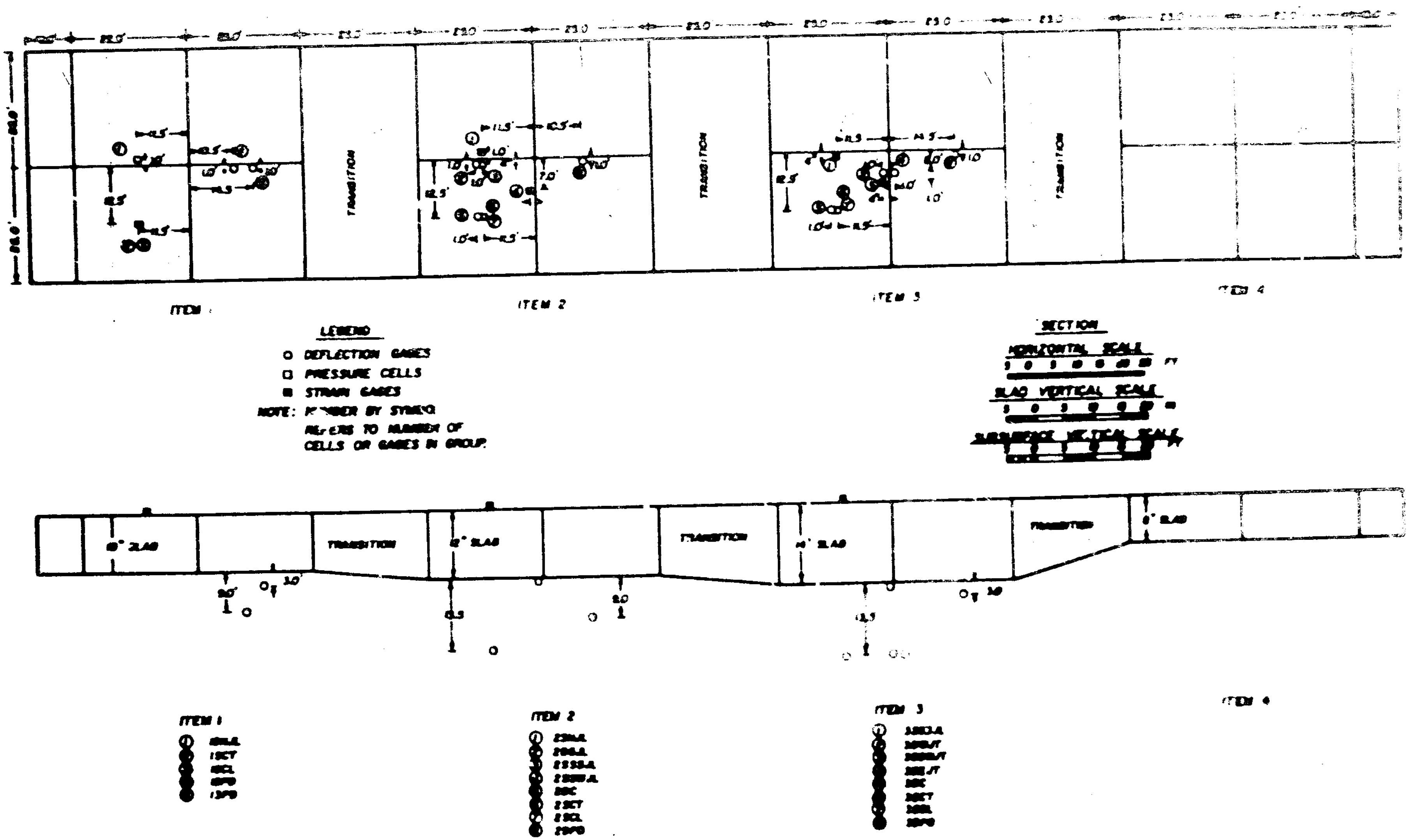

Figure 2. Instrumentation layout for 12 wheel traffic, rigid pavement test section

variations undoubtedly occur during the course of the design life. These variations have a rather decided impact or a strain or deflection history analysis.

MWHGL Test Track Data. The data collected from test tracks were analyzed using the strain history approach. Because detailed strain history data for rigid pavement performance are available from the MWHGL test reports, extensive use was made of this data. Figure 2 shows a layout of the MWHGL test track and locations of instrumentation. Traffic was applied to the test track pavement in five lines as shown in Figure 3 in order to simulate the wander of typical operational C-5A aircraft. A

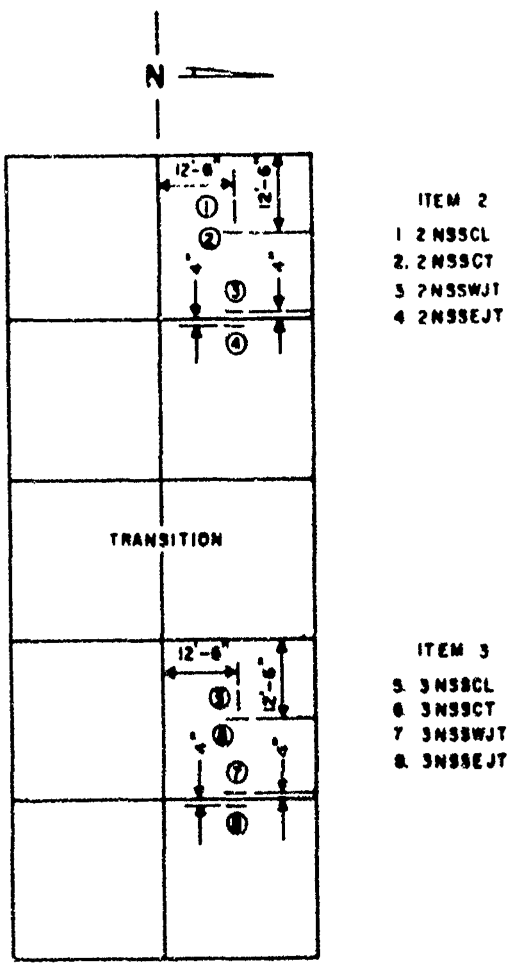

Figure 2a. Instrumentation layouts for the twin tandem assembly, rigid pavement test section.

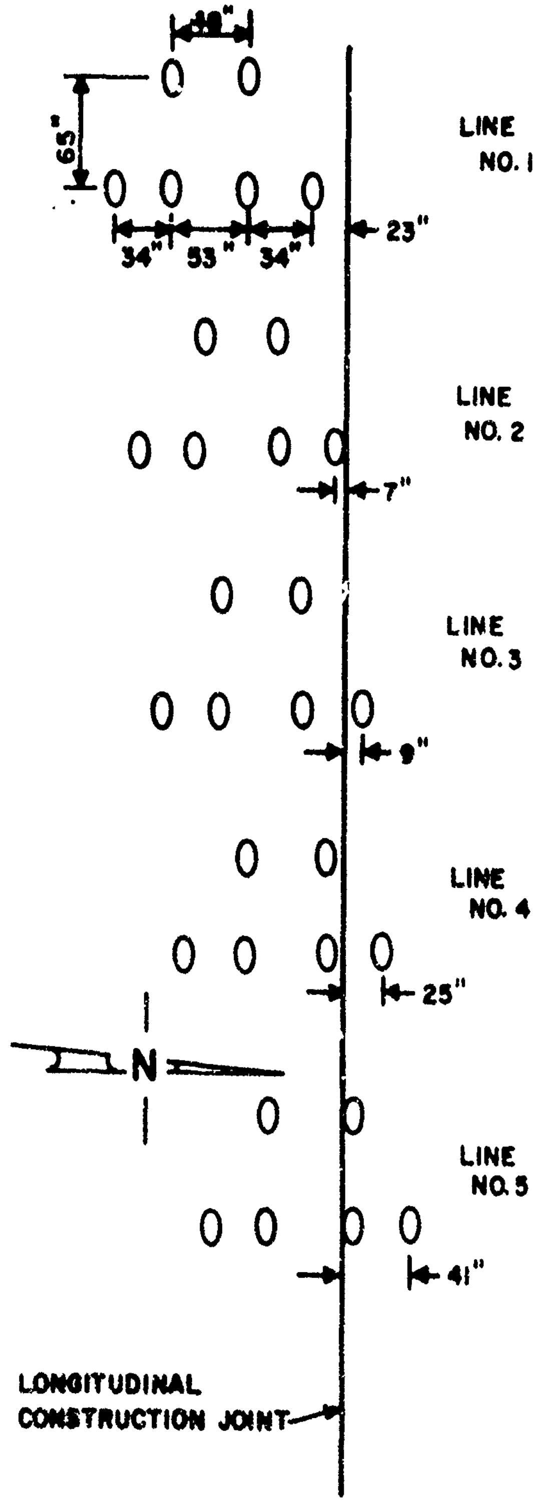

Figure 3. Traffic patterns for the C 5A wheel assembly, rigid pavement test section.

similar series of traffic tests was applied to the test items to simulate 747 traffic. The traffic lines for these loadings are shown in Figure 4.

The response data for each test slab were collated in strain history format. In order to utilize this data, a procedure for weighting the strain excursions was necessary. Several weighting functions were examined during the initial phases of the study. The method chosen to weight the magnitude of strain excursions which are measured from maxima to minima was based on Saint Venent's maximum strain theory of failure. The maximum strain theory assumes that failure occurs simultaneously as the elastic limit of the material is reached. This failure theory is primarily applicable to materials which fail by brittle fracture such as concrete. The maximum strain for conventional paving quality concrete is on the order of 200 micro inches per inch. Thus, strain excursions were divided by 200 micro inches per inch to provide a ratio of the magnitude of each excursion to the maximum strain which can be tolerated by the concrete. A somewhat similar technique was employed to weight the magnitude of the deflection excursions. Some limited data were collected to determine an approximate value of elastic deflection normally associated with initial failure of rigid airfield pavements over a normal design life. The value selected as typical was 0.05 inches. It should be noted that the selection of a base deflection or datum value can be rather arbitrary as the value is merely used to establish a relative weighting index. All excursions are expressed as a ratio of the datum deflection.

The relative merits of using a strain or deflection history were examined. More meaningful results were obtained using the strain history approach as compared to deflection because of the large number of factors affecting deflection. This would appear reasonable as pavement design and analysis procedures are predicted on stress rather than deflection. Another consideration which tends to favor the strain history approach is the fact that equal deflections can be vastly different in damaging effects due to difference in radius of curvature. Deflections are less sensitive to interaction between wheels and gears.

Measurement of strain in the MWHGL pavement tests was accomplished at the center and edges of Test Items 1, 2 and 3 in the longitudinal and transverse directions for the total test program. An example of a typical strain history for lane 2 is shown in Figure 5. Histograms were prepared showing the number of strain excursions per pattern versus the magnitude of the excursion. The interval for the histogram is 5 micro inches per inch. Histograms for strain measured in test items 1 to 3 are shown in Figures 6 through 8. Each strain excursion was weighted by dividing by 200 micro inches per inch and the number of occurrences of this weighted strain was considered by multiplying the quotient by the natural logarithmic of the number of occurrences. This calculation was performed for each interval of the histogram and summed. Table 1 shows the value of each of the weighted histograms for the C-5A test program. It should be noted that these weighted histogram areas must be evaluated in light of the performance of the MWHGL test items. Item 1 had a crack prior to the application of traffic. Test item 3 experienced a first crack prematurely due to a subgrade pumping failure. Test item 2 performed in a normal manner and can be used as a basis for normalization of the data.

Table 1

Weighted Areas for the 12-Wheel MWHGL Traffic Histograms - H_T

Test Item No.	Gage No.	At First Crack	For Total Traffic
1	1 SNJL	1.90	22.88
	1 SCL	5.62	39.59
	1 SCT	1.63	32.13
2	2 SWCT	50.23	55.76
	2 SSJL	69.84	77.47
	2 SCL	55.15	61.24
	2 SCT	14.27	15.82
3	3 SWJT	21.56	48.99
	3 SCL	4.55	10.33
	3 SCT	13.96	32.81

The use of jointed edge histories was later abandoned due to difficulties in correlation brought on by mathematically modeling the jointed edge. The assignment of a value for load transfer at a jointed edge is at best a tenuous estimate. Joint efficiency changes with time and increased traffic volume and has a large impact on strain and deflection history computations. For design purposes a load transfer value of 25 percent is assumed for the entire design life of a pavement. The 25 percent

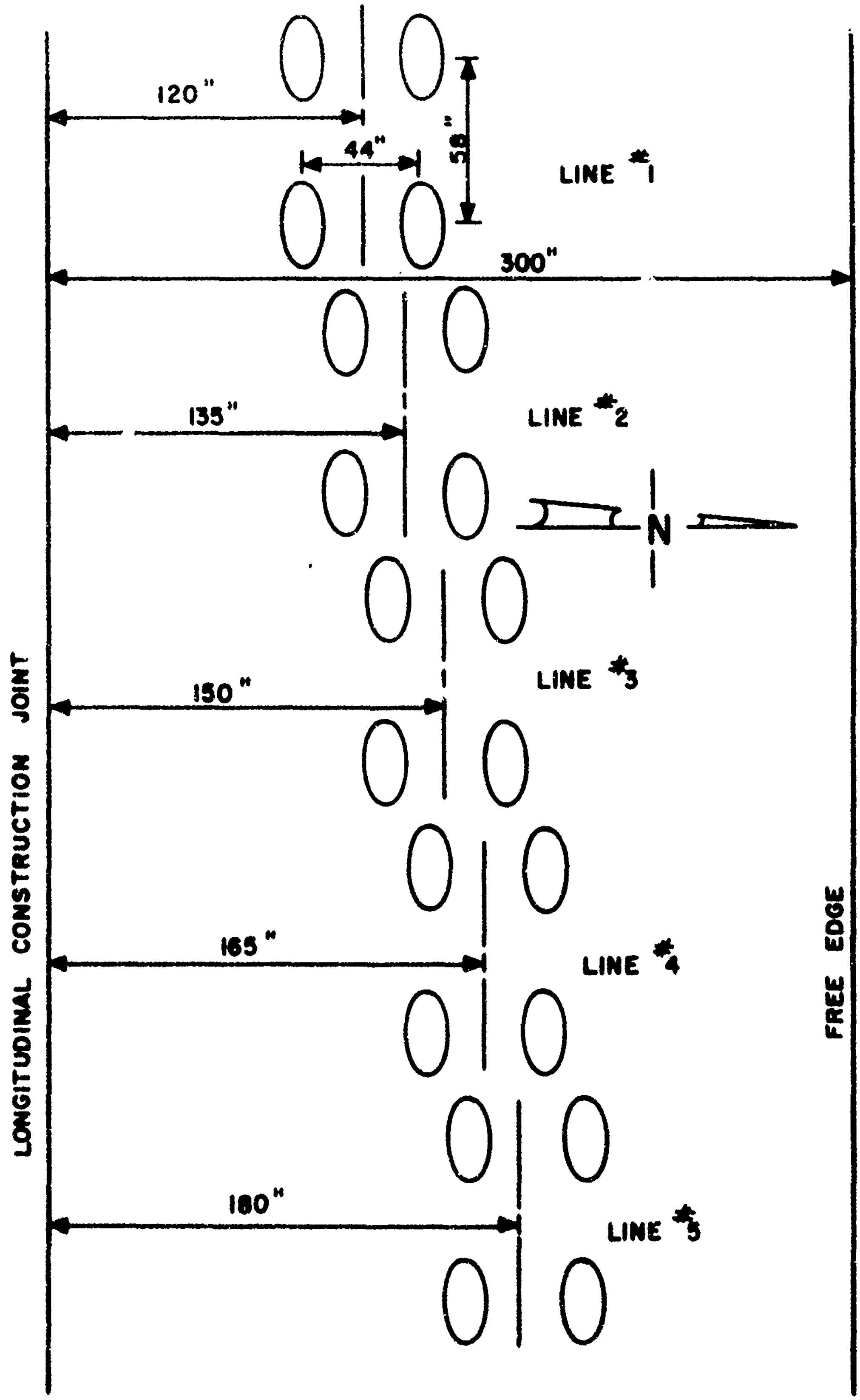

Figure 4. Traffic patterns for twin-tandem wheel assembly, rigid pavement test section.

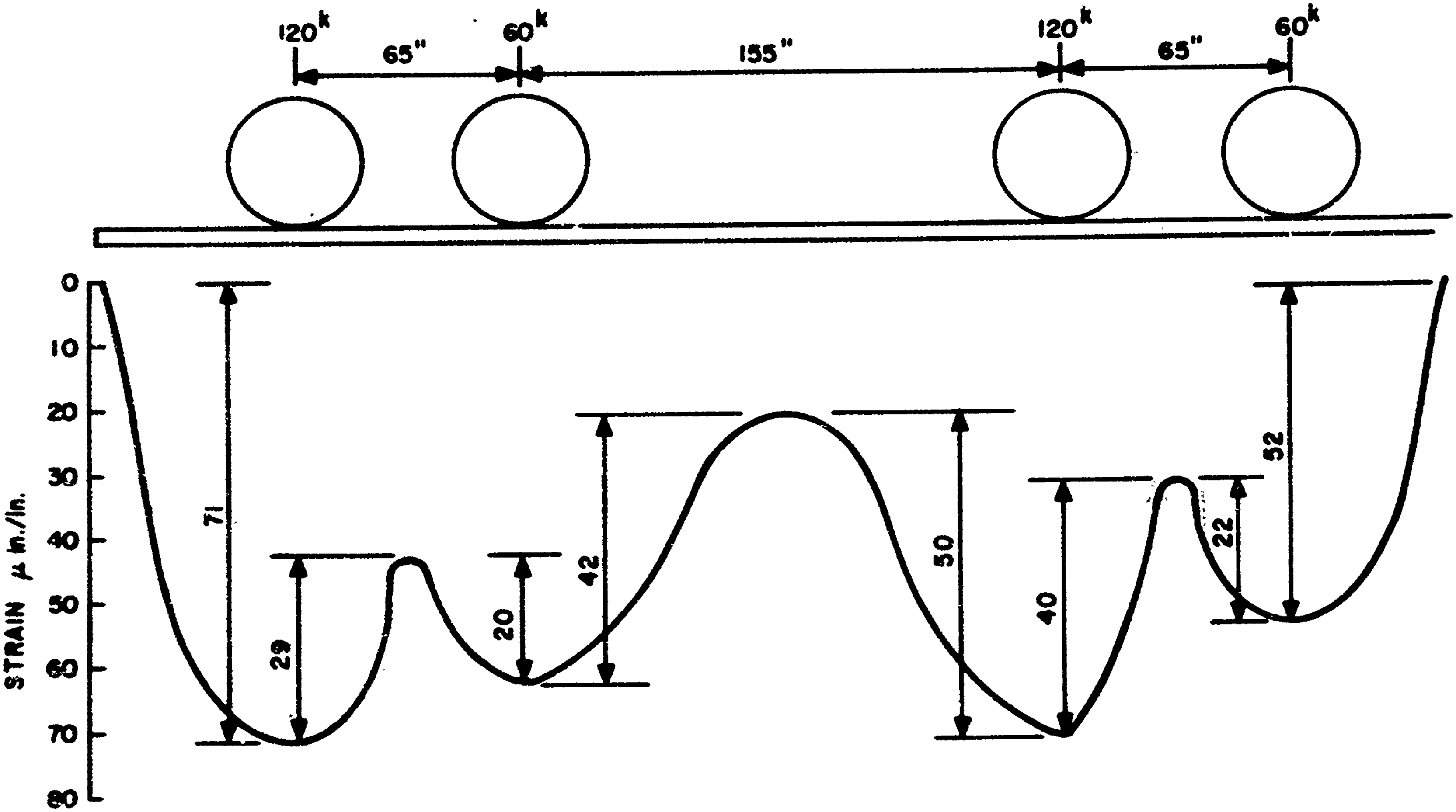

Figure 5. Typical strain trace under 12-wheel traffic showing strain profile for one pass. Note: gage 2SCL, test item 2; surface strain gage; longitudinal direction; gear on traffic line 2; pavement thickness = 12.1 in.; subgrade modulus k = 78 pci; concrete flexural strength = 800 psi. Outside wheel of gear is passing gage at a distance of 16 ft.

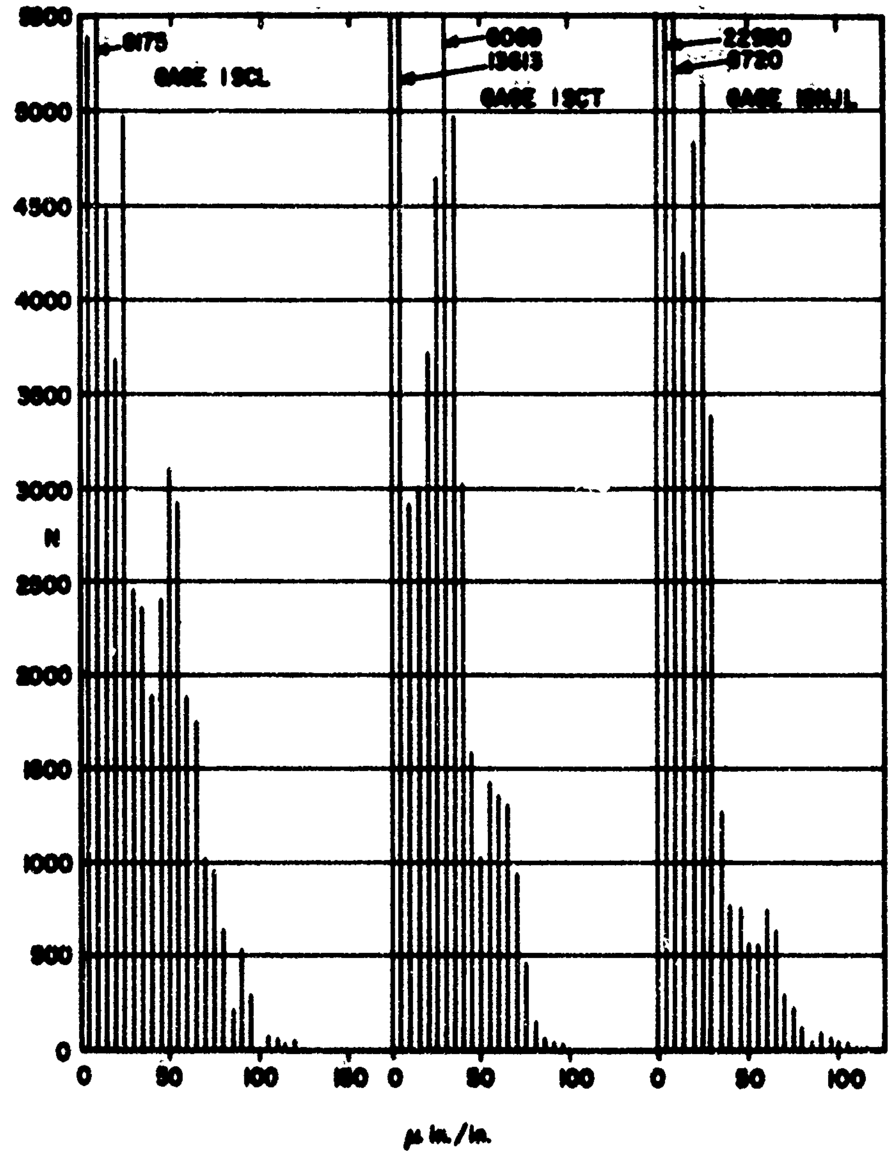

Figure 6. Histograms for strain excursions under 12-wheel traffic, item 1, rigid pavement test section.

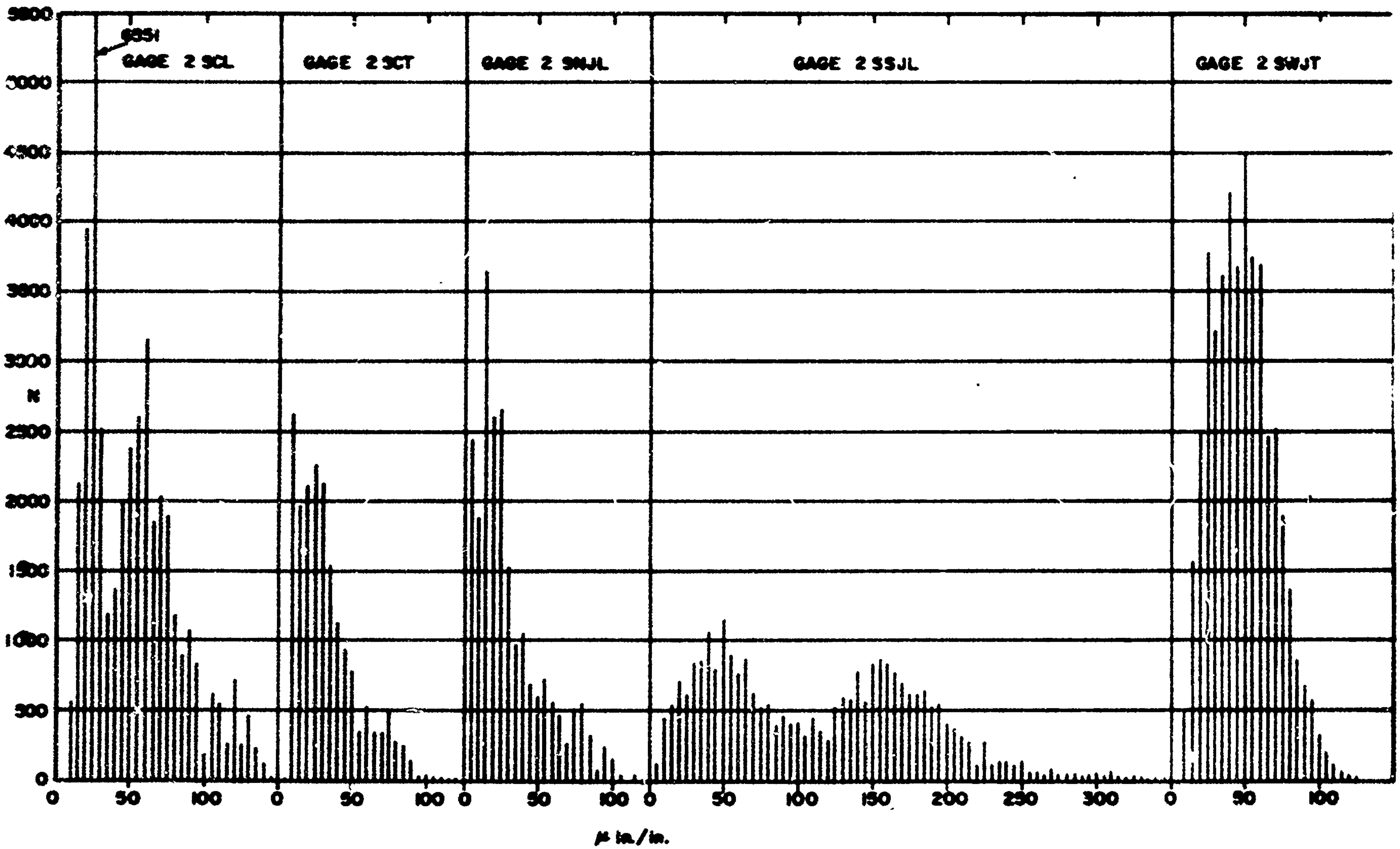

Figure 7. Histograms for strain excursions under 12-wheel traffic, item 2, rigid pavement test section.

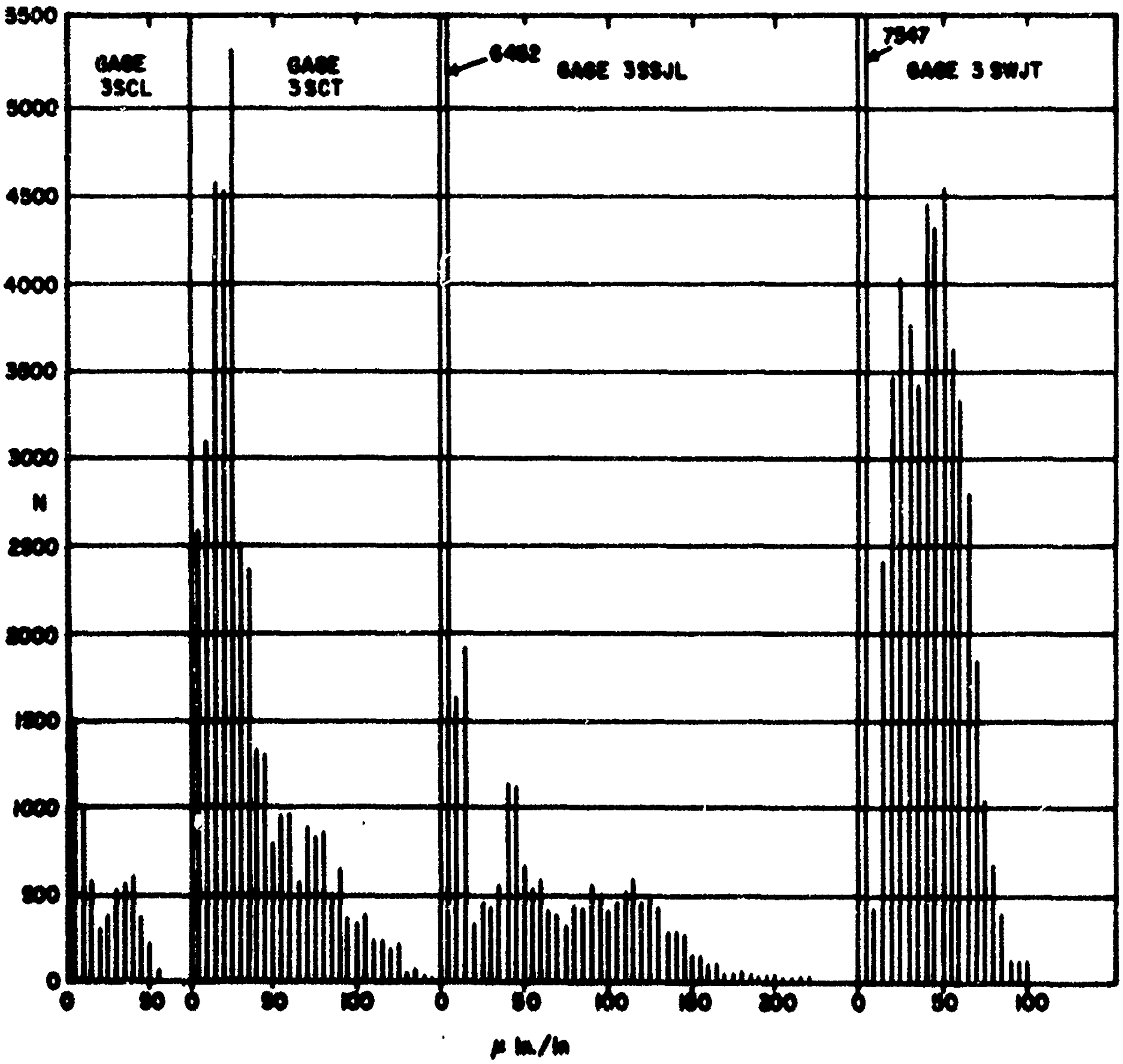

Figure 8. Histograms for strain excursions under 12-wheel traffic, item 3, rigid pavement test section.

assumption has been demonstrated to be reasonable for design purposes through test track experiments and inspections of in-service pavements. The strain history approach is much too sensitive to the load transfer value to use an average value for the life of the pavement. Emphasis was shifted from the use of a jointed edge loading to an interior loading condition. The use of an interior loading condition eliminates a number of boundary conditions which are difficult to represent mathematically.

The twin tandem 747 traffic which was applied to the test items provides a mechanism for evaluating the interior slab loading technique in as much as this traffic was applied at the center of the slabs as shown in Figure 4. Histograms for the strain excursions in Test Item 2 produced by this traffic are shown in Figure 9. Table 2 shows the weighted areas for these histograms for test items 2 and 3. The areas were adjusted to the initial failure condition and 15 traffic patterns for test items 2 and 3, respectively.

Table 2

Weighted Areas for Twin-Tandem MWHGL Traffic Histograms

Test Item No.	Gage No.	At First Crack	For Total Traffic
2	2 NSCL	5.75	97.74
3	3 NSCL	71.41*	(38.73) Gage Failure

*Reconstructed from histogram of traffic up to gage failure.

5 MIXED TRAFFIC

Chapter 3 discussed a procedure for generating load histories from gear pattern contours for particular aircraft configurations and pavement designs. Chapter 4 presented a hypothesis which establishes a total weighted area traffic histogram, H_T, which is a unique characteristic of the fatigue life of each pavement system.

In order to examine the relative severity of mixed traffic loading for which test track is not available, a series of calculations can be made using the program described in Appendix A to calculate weighted histogram areas. The wander pattern for traffic on a taxiway is as shown in Figure 10. Traffic distribution which is typically contained in the central 40 inches of the taxiway wander pattern accounts for 75 percent of all traffic.[7]

The technique for generating histograms is based on the calculated stress distribution. The weighted area histogram (H_S) is obtained as follows:

$$H_S = \sum_{j=1}^{M} \left[\frac{\Delta\sigma_j}{E_c\,\epsilon_f} \ln A_j\right] \qquad \text{[Eq 1]}$$

where $\Delta\sigma_j$ = sum of stress excursions in lane j
E_c = Young's modulus for the concrete pavement
ϵ_f = maximum strain at failure
A_j = proportional area of the wander pattern in lane j
M = the number of lanes in the distribution pattern.

H_S represents the area of the weighted histogram for a single pass. For multiple passes represented by the wander distribution A_j the traffic histogram H_M is obtained from:

$$H_M = \Sigma \left[\frac{\Delta\sigma_j}{E_c\,\epsilon_f} \ln A_j N_p\right] \qquad \text{[Eq 2]}$$

If we wish to compare complex traffic patterns, we must solve equation 2 for N_p.

$$N_p = e^{\dfrac{E_c\,\epsilon_f H_M - \Sigma(\Delta\sigma_j \ln A_j)}{\Sigma\Delta\sigma_j}} \qquad \text{[Eq 3]}$$

Equation 3 can be used to estimate the impact of a complex mix of traffic simply by summing the individual distribution patterns as follows:

$$N_p = e^{\dfrac{E_c\,\epsilon_f H_T - \Sigma\Sigma(\Delta\sigma_{ij} \ln A_{ij} N_i)}{\Sigma\Sigma\Delta\sigma_{ij}}} \qquad \text{[Eq 4]}$$

where H_T = the design weighted histogram area for the life of the pavement
σ_{ij} = the stress excursion for aircraft i in lane j
N_i = ratio of i type aircraft operations to total aircraft operations occurring on a periodic basis.

[7]Robert F. Baker, *Report of Photogrammetric Methods for Measuring Lateral Placement of Aircraft*, Lockbourne AFB (Ohio State University, 1966).

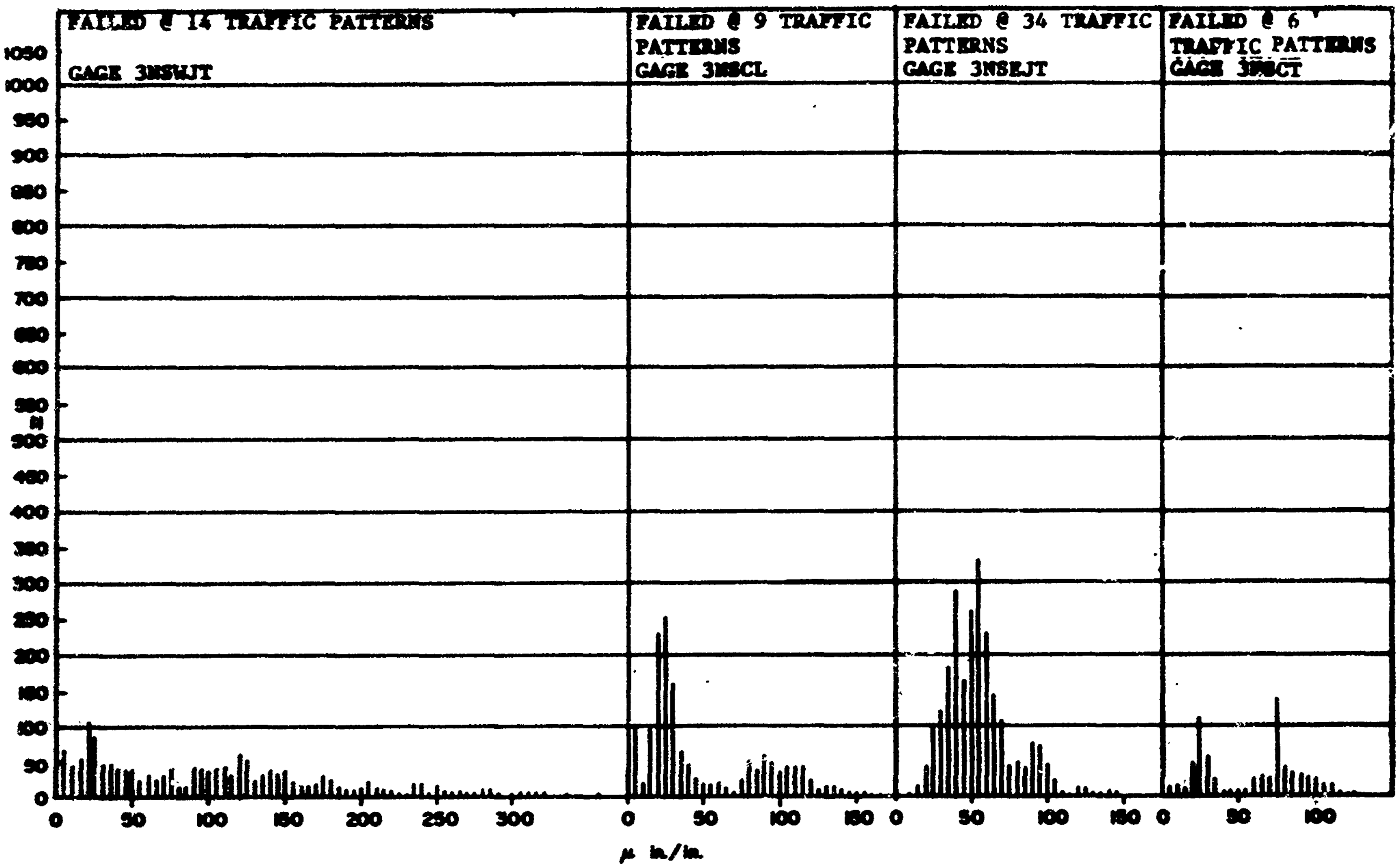

Figure 9. Histograms for strain excursions under twin-tandem traffic, item 3, rigid pavement test section.

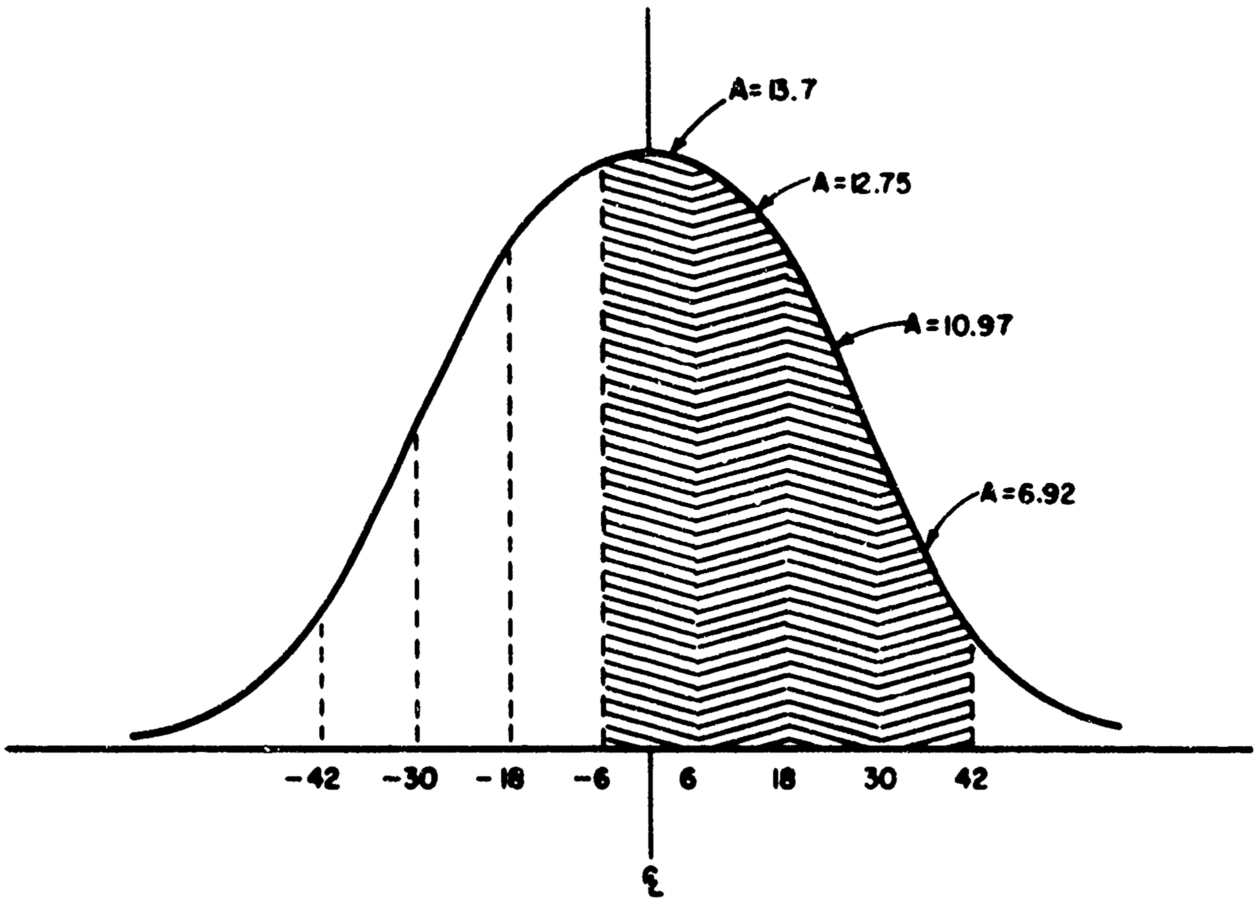

Figure 10. Wander pattern for runway loading.

Table 3

Weighted Strain Histogram Areas H_M for 1,000 Passes

Gear Configuration	Total Area
25,000 # Single Wheel	3.52
B-52	57.49
C-141	27.98
B-47	24.78
KC 135	31.27

Table 3 shows accumulated stress excursion levels for the 25,000 lb single wheel load, the B-52, B-47, KC-135 and C-141 aircraft systems. The pavement is a 12-inch thick slab with a radius of relative stiffness of 50 in. Weighted histograms were then developed by summing the individual stress excursions along traffic lanes spaced for each 12-inch segment of the wander pattern which represents the appropriate traffic density.

Table 4 is a report of aircraft traffic compiled by base operations of a typical heavy load Air Force base selected at random. Data of this type have been compiled for some 24 heavy load Air Force bases over a four-year time period. On the average, the typical heavy load Air Force base experienced 100 cycles of B-52 traffic per month and 95 cycles of KC 135 traffic. A considerable amount of variation occurred in the traffic operations, however, as the standard deviation for B-52 traffic was 64 and for KC 135 the standard deviation was 51.

Some of the variation is probably due to differences in the numbers of aircraft stationed at a base. In some instances different numbers of squadrons, groups or wings are stationed at different Air Force bases. Variations in numbers of aircraft are reflected in the above standard deviations.

The distribution of aircraft traffic on taxiway and runways has been studied to a limited extent[8] and has been shown to be approximately normally distributed. These studies indicated that 75 percent of aircraft traffic is concentrated with a wander of 7.5 feet on primary taxiways and 37.5 feet on runways at

[8]Robert F. Baker, *Report of Photogrammetric Methods for Measuring Lateral Placement of Aircraft*, Lockbourne AFB (Ohio State University, 1956).

Table 4

Report of Selected Aircraft Traffic Data

CYCLES OF OPERATION*										
TYPE AIRCRAFT										
		Medium Bomber		Tanker		Cargo				
Month of Report Period	Heavy Bomber B-52	B-47	B-52	KC-135	KC-97	C5A Other	C-135, C-139 C-141	C-124	Other	All Other Aircraft
	A	B	C	D	E	F	G	H	I	J
First JUL	259			298			8	77	624	1034
Second AUG	301			347	4		8	116	675	1297
Third SEP	259			351	2		15	102	722	1176
Fourth OCT	216			317	1		14	113	593	1457
Fifth NOV	258			343			9	105	637	1467
Sixth DEC	200			260			12	77	525	1048
Totals *	1493			1919	7		66	550	3776	7479
AVG. TAKEOFF Wt. (Kips)	400M			235M	175M		323M	185M		
AVG. LANDING Wt. (Kips)	200M			125M	104M		257M	168M		
AVG. WEIGHT Range (Kips)										

*A cycle of operation is composed of one takeoff and one landing of the aircraft.

about the runway midpoint. The Corps of Engineers design method for pavements is based on 75 percent of the traffic occurring within the limits of the traffic area width. The data generated above from past operational records would indicate that over a 20-year design life at an average heavy load base, 24,000 cycles of B-52 and 22,800 cycles of KC 135 traffic will be encountered. Applying the 75 percent adjustment for traffic design yields—18,000 cycles of B-52 and 17,100 cycles of KC 135 traffic. Using the existing Corps of Engineers method for describing traffic, the above traffic volumes would be converted to 9000 coverages of B-52 traffic for taxiways and 4500 coverages for runways. These figures agree well with 10,000 coverages and 5000 coverages used for design. In the present design method for heavy load pavements the KC 135 traffic would be ignored. This is in contrast to the relative strain history areas shown in Table 3 which indicate that the KC 135 traffic is 54 percent as severe as the B-52 traffic. Thus, the total traffic would be computed as $9000 + 17.1/18 \times .54 \times 9000 = 13{,}617$ coverages for the taxiways and implies that the traffic volume used in the design of taxiways and runways is understated by 36 percent.

6 ANALYSIS AND DISCUSSION

Several problems arose during the course of this study which tend to limit the degree of validation which is possible. No data are available on the behavior of pavements under mixed traffic loadings under ideal test conditions. Data from various test tracks with similar properties and performance records were compared. A prime consideration in studying the effects of wheel interaction is the radius of relative stiffness which controls wheel interaction. Thus past test track data had to be analyzed on approximately the same basis to achieve meaningful comparisons. This requirement limited the data available for comparative analysis.

Computer analysis of pavement response is essential when using the strain history approach. No convenient manual method could be devised which would yield meaningful results. The output required to produce a significant strain history is too detailed for manual computation except for single wheel loadings. Wheel interactions on multi-wheeled gears are too complex to produce without the aid of a digital computer.

It has been necessary to make a number of implicit assumptions relative to the hypothesis advanced in this study which defines a weighted area histogram as a unique characteristic of each pavement systems. These assumptions are listed below:

1. A lower threshold for fatigue failure produced by strain excursions in a pavement does not limit the level at which a significant portion of the strain excursions are accumulated during the pavement life.

2. The relative severity of strain excursions is a function of the log of the number of loading cycles.

3. The weighted histogram area, H_T, at which fatigue failure occurs is a function of the strain excursion history only and is unique for each pavement system design.

The strain history technique yields reasonable results and can provide a basis for designing airfield pavements for a given level of mixed traffic. The method provides a much more realistic assessment of traffic on rigid pavements than the coverage concept as wheel interaction is taken into consideration. The coverage concept merely considers surface geometry; interactive effects are left to judgment and experience.

7 CONCLUSIONS AND RECOMMENDATIONS

Conclusions. Based on the results of the study reported herein, several conclusions can be drawn concerning the strain history method of assessing field traffic loadings.

The strain history approach appears to be a viable technique to assess multi-wheeled aircraft traffic effects on pavements.

The strain history approach should be based on interior loading conditions due to the difficulties encountered in modeling jointed edge boundary conditions. If sufficient assumptions are made concerning the jointed edge boundary conditions to permit a comparative analysis from the same reference, the analysis may as well be performed using interior loading conditions. The analysis is intended to

demonstrate relative effects rather than absolute values.

The deflection history approach was abandoned early in the study as the deflection approach was not sensitive enough to wheel interaction to provide meaningful data.

The strain history approach is a reasonable technique for analyzing the effects of mixed traffic on airfield pavement performance. The weighting functions applied to strains and repetitions will permit mixed traffic to be assessed from a common basis. Insufficient data is available to verify the nature of the Fatigue-Cyclic Excursions (F-N) Curve for concrete pavements. The assumption that the relationship is a log function needs to be verified. An assumption that fatigue strain is linearly proportional to the ratio of the strain excursion experienced to that at failure is undoubtedly an oversimplification. The relationship is probably influenced by the strain level beyond that purely linearly position of the stress-strain diagram with a minor influence up to that point.

Recommendations.

1. The Corps of Engineers rigid pavement design criteria should be based on histograms of strain distribution rather than coverage concept for describing traffic volume.

2. Lateral positioning of aircraft on taxiways and runways during normal operations should be investigated. Previous studies are rather old and should be updated to reflect changes in aircraft and operational characteristics which may affect aircraft placement during normal operations.

3. The nature of the weighting factor to be applied to strain excursions should be verified by either model tests or traffic data.

4. A program for the collection and analysis of field data for correlation should be undertaken particularly for new pavements.

APPENDIX A: SLAB 30E—A COMPUTER PROGRAM FOR AIRFIELD SLAB ANALYSIS

This appendix presents the documentation of a computer program developed by Austin Research Engineers Inc. for the U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, Illinois. The work was conducted under Contract No DACA 23-70-C-0076 by Mr. John J. Panak. Mr. Frank L. Endres was the programmer who made the revisions to the original program and performed the checkout work on the CERL input facility.

The FORTRAN Program. Program SLAB 30E is an extensive update and revision of a program called SLAB 30 which is reported by Stelzer and Hudson.[9] It has features which allow it to work more efficiently than SLAB 30, and in addition, includes three significant new developments which are:

1. Addition of a printer plot routine to allow a visual display of selected lines of output values of deflection, bending moments and principal stresses.

2. Addition of a feature which will allow a particular wheel load pattern, such as that associated with the C-5A, to be simply input to the computer model by reference to a single input coordinate.

3. Addition of a data input generation routine which will allow much simpler definition of the pavement slab in terms with which the investigator is accustomed.

The program is written to operate on any Control Data Corporation Model 200 remote user terminal which can access a CDC 6600 computer. All programming is in ASA FORTRAN and therefore is compatible with other computers such as IBM 360 and UNIVAC 1108 systems.

Storage Requirements. The storage requirements are variable, depending upon the size of the problem to be run. Cards which must be changed for different sized problems are specified at the beginning of the program and only include the dimension statements and two variables which define the number of increments in both directions. It is not necessary to match exactly the dimensioned storage to the problem, any size larger is also acceptable. It is recommended that several dimension packages be made of those cards with RE-DIMEN in columns 73 through 80 of the main driving program (refer to program listing). These packages can be of multiples of width and length of 10 or 20 stations up to the maximum acceptable for the particular computer being used. A plot of the CDC 6600 storage requirements is shown in Figure A1. If necessary to gain more storage space, certain variables could be placed in common. In addition, others may be set equal to each other in storage by an equivalence declaration. Common and equivalence statements have not been added in the program for normal operation, to avoid initial confusion when converting to other computer systems. All subroutines in the program are variably dimensioned as functions of the short (X) and long (Y) lengths, which are specified in the main driving program.

Input of Problems. The procedures that are followed in input of problems are outlined in the Guide for Data Input. A parallel study of the guide will help to understand the following discussion. Any number of problems may be run at the same time.

The first two cards of a problem series are for identification purposes. Any alphanumeric descriptive information desired can be entered. It is suggested that the date of the run and the user's name always be entered within these two cards. The next card is the problem number card with a brief description of the particular problem. The problem number itself may contain alphabetical characters if desired. The problem series terminates when a blank problem number is encountered.

Tables of Data Input. Table B1 is used to input the problem control data and is composed of a single data card that specifies the multiple load option and the number of cards in the following data Tables B2 through B7. The Multiple Load Option in column [illegible] of Table B1 is left blank if each successive problem is independent of the preceding problem. If a following problem is for the same slab but only the load pattern and placement are to change, the first problem in the loading series is specified with a +1 for the option. This will be the "parent" problem. Each

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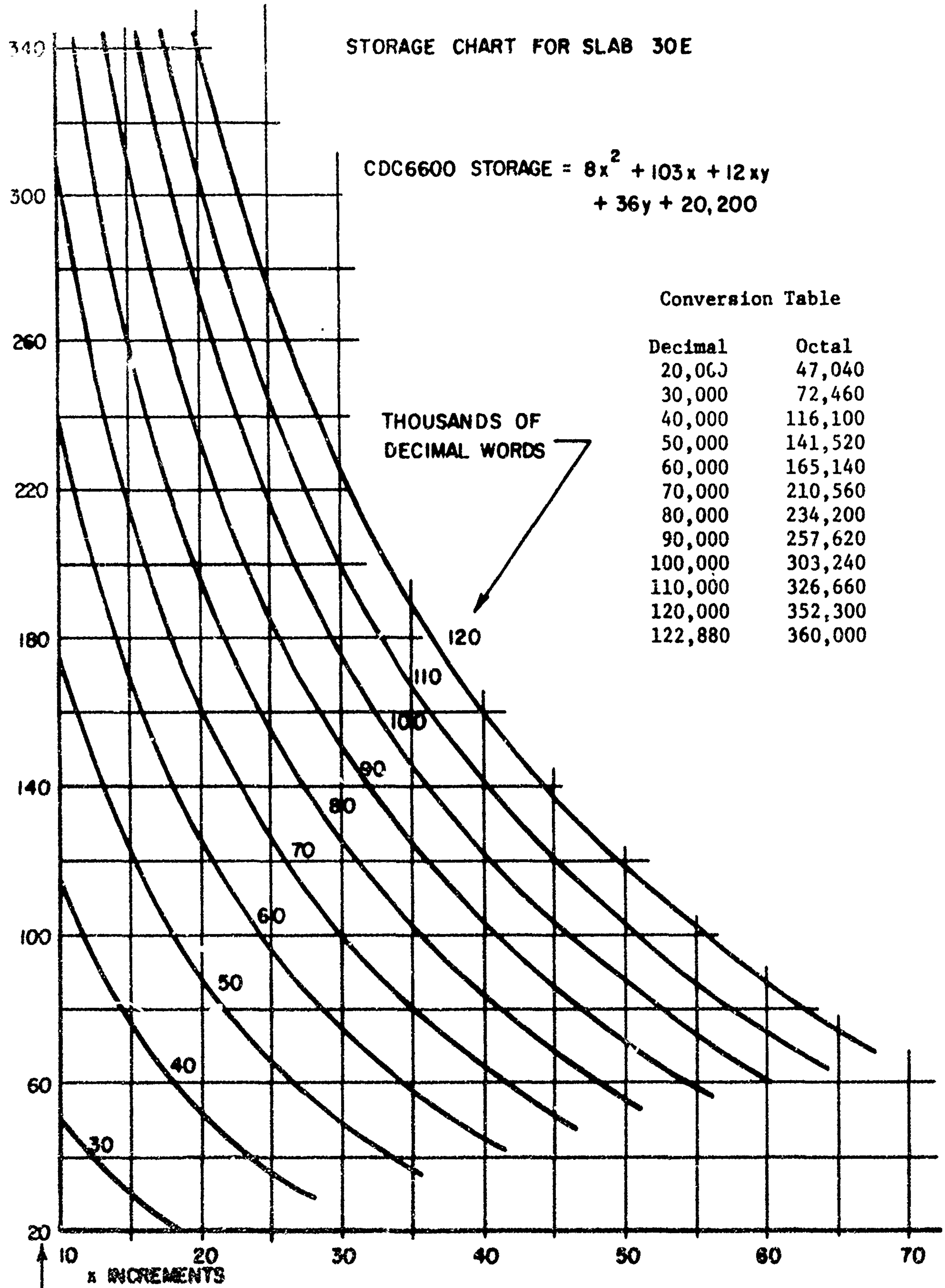
[9] C F Stelzer and W. R Hudson, *A Direct Computer Solution for Plates and Pavement Slabs*, Research Report 56-9 (Center for Highway Research, University of Texas, 1967).



Conversion Table

Decimal	Octal
20,000	47,040
30,000	72,460
40,000	116,100
50,000	141,520
60,000	165,140
70,000	210,560
80,000	234,200
90,000	257,620
100,000	303,240
110,000	326,660
120,000	352,300
122,880	360,000

Figure A1. Approximate storage requirements for SLAB 30E.

successive loading must have a -1 for the option and these will be termed "offspring" problems. When a blank option or another +1 is encountered, that problem is then another independent problem or a new parent problem.

The optional stiffness input switches in columns 55, 60, and 65 may be used to automatically compute conventional slab or plate stiffness values by entering a one for the options selected. Appropriate values must then be made available in Table B2. If D^x or D^y or C are to be computed, then there must be real values available for E and t in Table B2. If a uniform value of S is to be computed, then a subgrade modulus k must be available. The stiffness options must be left blank for offspring problems.

Two Output Options may be specified in columns 75 and 80. All of the detailed output of Table B8 may be omitted if desired. The user is cautioned when using this option that he could omit what might later be desirable information. Deletion of output reduces central computer time only a small amount. It may, however, decrease turn-around time due to reductions in peripheral processor time and printer time. If the output is suppressed, a single reference station is printed which is at or near the center of the slab. The other output option is exercised if the user desires the printout of principal stresses in place of principal moments. If the stress option is exercised, an appropriate value of slab thickness must then be available in Table B2. The principal moment is converted to a stress having the same sign by multiplication of the moment by the plate section modulus which is internally computed on the assumption of a uniform thickness of plate. The use of the stress option is only appropriate for plates of a constant thickness. At specified discontinuities in the slab, such as a crack or joint which might be modeled by means of a reduced bending stiffness, the output value of "stress" at that location may be misleading. A better estimate of stress at discontinuities, may be obtained by inspecting the variation in computed stress at several stations adjacent to the crack while incrementally moving the concentrated loads away from the crack.

Table B2 is used to specify the constants for the problem. These are the number of increments in the X and Y directions, the increment lengths in both directions, and Poisson's ratio. For efficient solution of the program, the number of Y increments must be equal to or greater than the number of X increments. Table B2 is omitted for offspring problems since the constants must be the same as in the parent problem. The constants specified for the parent are retained and used by all successive offspring problems.

Data for optional stiffness constants are also input in Table B2. The Modulus of Elasticity E and the slab thickness t must be specified if D^x, D^y, or C are to be internally computed by the options in Table B1. A uniform subgrade modulus k must be specified if S is to be computed. All of these three constants may be input if desired and thus printed for reference without the options exercised in Table B1. The options cause the computation of the equivalent data which could be input in Table B4 based on these customary plate stiffness relationships:

$$D^x = D^y = \frac{Et^3}{12(1-\nu^2)}$$

$$C = \frac{Et^3}{12(1+\nu)} \qquad \text{[Eq A1]}$$

$$S = kh_xh_y$$

The computed stiffnesses are constant over the X by Y area of the slab and appropriate quarter and half-values are generated at corners and edges. They are printed as an extension to Table B4, and thus any additional stiffness values entered in Table B4 are superimposed algebraically. By the addition of appropriate reduced lines of stiffness in Table B4, any degree of discontinuity may be modeled. Multi-valued subgrade moduli, or foundations with voids may also be modeled by entering the appropriate additive spring stiffnesses in Table B4.

Table B3 is used to define the lines or areas of selected output for deflection, bending moments in the X and Y directions, and either the maximum principal moment or stress depending on the print option in Table B1. The number of cards are as specified in Table B1 and may include up to a maximum of 10 cards. Each card may encompass up to a maximum of 300 points. That is, coordinates from 10, 10 through 20, 40 or from 0, 0 through 12, 25 could be specified. If a larger area is required, another card covering the adjacent area could be added.

The major advantage of Table B3 is that a crude printer plot display is also obtained for each area specified. This feature will be discussed more completely under the heading Computed Results. Table B3 is especially useful when studying the deflection and moment variations along a line or over a local area. Table B3 may be omitted if desired, since all selected output values are duplicated in the complete printout of results in Table B8. The selected output is controlled by the same input joint coordinate system described below for Table B4. The user is cautioned when omitting Table B3, since he may have elected to suppress the complete printout of results by the option in Table B1. It is thus possible to use a significant amount of computer time and print no results.

Table B4 has the number of cards as specified in Table B1. Card counts should be carefully checked. It is recommended that a listing of the data cards be checked by the user prior to submission of the program for a run.

Stiffness and load data are entered by a coordinate system notation. The coordinates refer to the discrete-element model of the slab. A joint is defined as occurring at the intersection of the station lines in each x and y-direction. A mesh is defined as that area surrounded by four joints. A bar is defined as the discrete-element length between adjacent joints. Figure A2 of the Guide for Data Input summarizes this notation. Note that mesh data cannot have either a zero x or zero y-coordinate; x-bar data cannot have a zero x-coordinate, and, similarly, the y-bar cannot have a zero y-coordinate. If the data occur only at one location (such as a concentrated load), the From and Through coordinate is simply repeated. If the data occur along a line, the coordinates will reflect this by having either both x or both y-coordinates the same. Data distributed over a rectangular area are specified by entering the lower left and upper right coordinates of the area.

Values of stiffness entered in Table B4 are added algebraically to the automatically created optional stiffnesses computed by Tables B1 and B2. Thus, the user has the ability to freely model any discontinuities that might exist in the actual pavement.

The orthogonal bending stiffnesses D^x and D^y are entered in each direction and are specified on a per unit width basis. If the edge of the slab coincides with a station line, a half-value of stiffness should be input for both D^x and D^y along the edge. If the edge of the real slab is not on a station line, a proportionate value of full stiffness is entered. This is demonstrated by a sample input in Figure A3 of the Guide for Data Input. The stiffness proportionment may be thought of as a direct function of the plan area of real slab surrounding each joint.

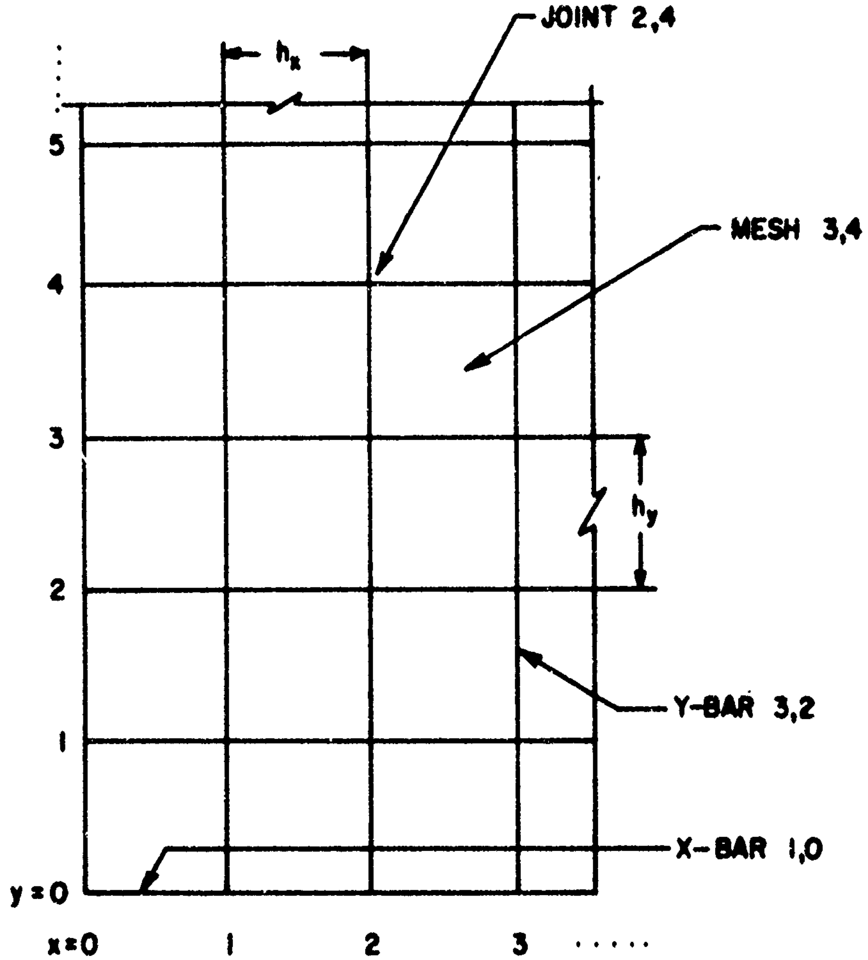
Load Q is concentrated on a per joint basis and may be apportioned at each joint by the contributory area loaded around each joint. Positive loads act upward. Loads that occur between joints may be fractionally proportioned to the adjacent joints. Support springs S are concentrated values input and apportioned exactly like loads. A rigid support may be specified by introducing a large value of support spring. A maximum value of 1×10^{25} is suggested to avoid computational difficulties for some computers. Loads may also be applied to the pavement by means of specified load pattern in Tables B6 and B7 discussed below.

The twisting stiffness C is input on a per unit width basis for each mesh surrounded by four joints. When the geometric edges of the actual slab do not fall on a station line, proportionate values of unit twisting stiffness may be input similar to bending stiffness proportionment. Computations of twisting stiffnesses for slabs or plates are at best still approximate procedures. This is due to uncertainty in the defining of the shearing modulus of rigidity. The best procedure is to ascertain the twisting stiffness experimentally as outlined by Reference 10. The formulas shown above in the Table B2 discussion are correct for uniformly thick isotropic plates. An approximate value of twisting stiffness for orthotropic slabs or stiffened plates may be obtained by using procedures outlined by Huffington[11] or computations summarized by Troitsky in a recent publication.[12] Fortunately, precise values of twisting stiffness are unnecessary to model a slab. The main load

[10]W. R. Hudson and Hudson Matlock, *Discontinuous Orthotropic Plates and Pavement Slabs*, Research Report 56-6 (Center of Highway Research, University of Texas, 1966).

[11]N. J. Huffington, Jr., *Theoretical Determination of Rigidity Properties of Orthogonally Stiffened Plates* (Applied Mechanics Division, ASME, 1955).

[12]S. Timoshenko and S. Woinowsky-Krieger, *Theory of Plates and Shells*, Engineering Society Monographs, 2nd Ed. (McGraw-Hill, 1959).



JOINT DATA: D^x, D^y, Q, S

(D^x AND D^y ARE PER UNIT WIDTH, Q AND S ARE CONCENTRATED)

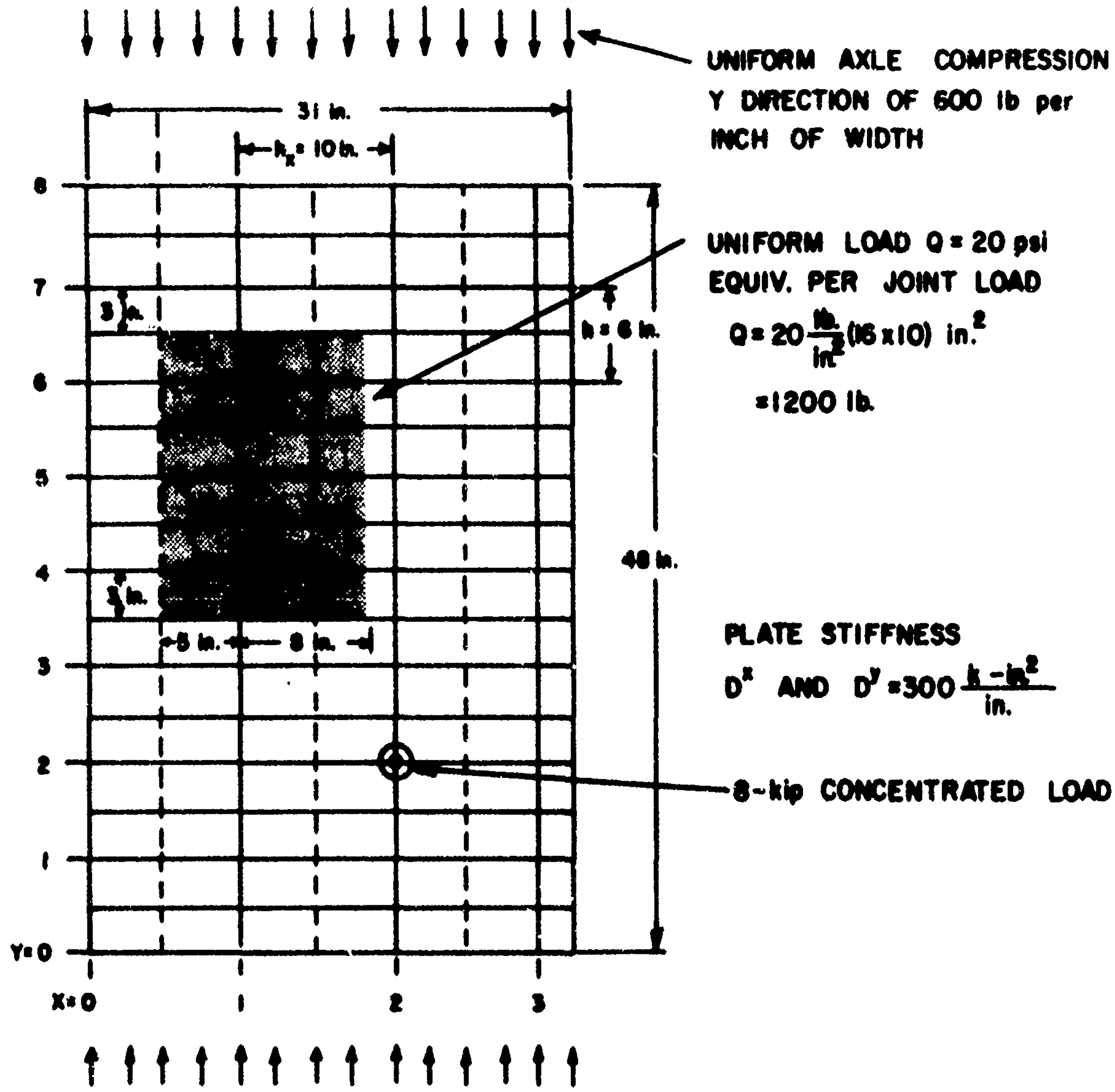
MESH DATA: C

(C IS PER UNIT WIDTH)

BAR DATA: P^x, P^y

(P^x AND P^y ARE CONCENTRATED)

Figure A2. Data coordinate numbering system.



FROM X	FROM Y	THROUGH X	THROUGH Y	D^x AND D^y	Q	P^y
0	0	2	8	7.500E+04		
0	1	2	7	7.500E+04		
1	1	2	7	1.500E+05		
3	0	3	8	9.000E+04		
3	1	3	7	9.000E+04		
1	4	1	6		-1.200E+03	
2	4	2	6		-3.600E+02	
2	2	2	2		-8.000E+03	
0	1	0	8			-3.000E+03
1	1	2	8			-6.000E+03
3	1	3	8			-3.600E+03

data incomplete for this sample

Figure A3. Sample data input.

carrying capabilities of a slab are due to its bending stiffness which is more accurately definable.

By using a zero value of twisting stiffness and zero Poisson's ratio, a simple grid system may be modeled. Each beam would be modeled by an appropriate D^x or D^y term which would then be the per unit width stiffness. The beam stiffnesses entered should therefore be divided by the increment width.

Table B5 is for input of in-plane axial tensions P^x or P^y if present. These might be generated due to temperature differentials or traffic braking and acceleration forces. There is no provision in the program for automatic distribution of applied axial forces since no in-plane supports are used which would restrain them. The user must specify the distribution of the axial tensions (+) and compressions (-) in each x-bar and y-bar of the model. Since these are bar forces, no data should be input which would represent forces outside the boundaries of the actual slab. A brief sample of data input is given in Figure A3 in the Guide for Data Input.

All data in Tables B4 and B5 are algebraically accumulated and values therefore may be added or subtracted regardless of other values specified.

Table B6 is for input of special load patterns such as are found on the C-5A or Boeing 747 aircraft. This table allows the user to specify one pattern which can then be repeated or placed several times on the same pavement. By this means, the placement of wheel load patterns by individual load inputs in Table B4 is unnecessary.

A maximum of nine different patterns may be specified with a maximum of 12 loads in each pattern. Each pattern requires two input data cards. The first card specifies the pattern number designation, the number of loads in the pattern, and the pattern coordinates. The pattern has its own local coordinate system, the only restriction being that the increment spacing is the same as for the complete pavement described by Table B2. The second card of the pattern is for the entry of the individual pattern load magnitudes. For loads between stations, a geometric apportionment of load could be used. The first pattern coordinate and load entered in columns 9 through 14 is the reference load for the pattern and is the load which is placed by Table B7. It may have any coordinate including negative values and may also have a zero magnitude of load which is sometimes convenient A typical pattern and Table B6 input is shown in Figure A4 of the Guide for Data Input.

For a problem series in which the effects of several load patterns may be studied, all patterns could be entered in Table 6 of the first problem. The selected pattern numbers are then applied to the slab by the Table B7 of each problem. The series can be parent and offspring problems, or individual problems in which stiffness might be changed from problem to problem. New patterns can be entered at any problem in the series and are then available for subsequent problems. If the same pattern number is used as was previously used, then the new pattern replaces the old pattern.

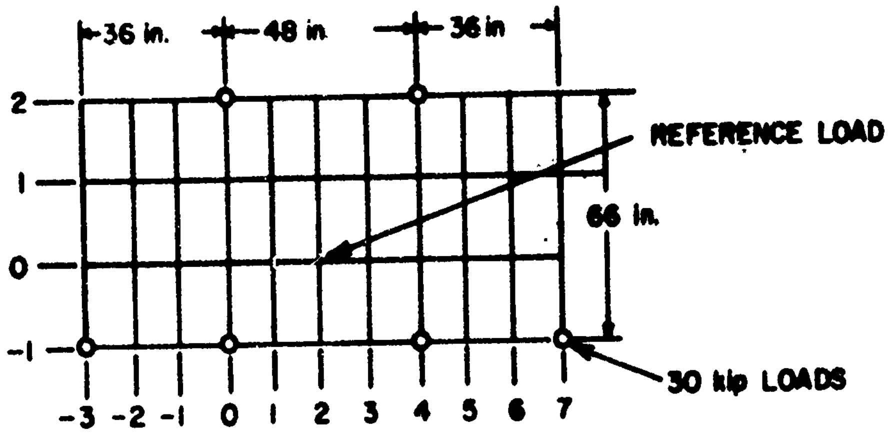
Table B7 is for the placement of any or all of the load patterns defined by Table B6. Any number of pattern-placement cards may be used. Placements of the reference load are by coordinates which are related to the overall system defined by Table B2. Placements outside the boundaries of the actual slab are permissable. Any loads of the pattern that thus fall off the slab are not included in the solution. The same pattern number may be repeated on several cards if desired. They need not be in numerical ascending sequence.

For offspring problems, only Table B1 and Table B4 with added loads are required. Any loads entered in the offspring Table B4 replace all other previous Table B4 loads. Offspring problems may also be run with only Table B1 and new load pattern placements in Table B7. Table B2, stiffnesses in Table B4, and Table B5 cannot be used in offspring problems. Tables B3, B6 and B7 may be used as desired.

Input Checklist. An input checklist is provided in Table A1 of the Guide for Data Input. A listing of the input data prior to problem submission will also aid in detecting coding and keypunch errors.

Data Errors. All data are checked for compatibility with the geometry of the specified slab and consistency of coordinate input. A count of the number of data errors is made and if any errors are encountered, the problem is terminated and a message showing the number of data errors made is printed. Typical errors are: 1. misuse of the multiple-load

PATTERN NO.



$h_x = 12$ in. $h_y = 22$ in.

Table B6 input for this pattern:

Pattern Num	Num of Loads in Pattern	x	y	x	y	x	y	x	y	x	y	x	y	x	y
2	7	2	0	0	2	4	2	-3	-1	0	-1	4	-1	7	-1
		0		-30000		-30000		-30000		-30000		-30000		-30000	

Figure A4. Typical special load pattern.

option, such as a -1 following a 0 in the preceding problem; 2. the number of increments in the x-direction exceeding those in the y-direction (if this were allowed, an inefficient and time consuming computer solution would result); 3. a negative or zero increment length specified; 4. a negative Poisson's ratio or thickness input; 5. the "Through" x or y-coordinate in a data specification numerically less than the "From" coordinate; 6. data specified outside the geometric limits of the slab (exceptions are Table B6 and B7 which allow load patterns to be outside slab boundaries); 7. a zero x or y-coordinate specified for a twisting stiffness; 8. a zero x-coordinate used for x-bar axial tensions or a zero y-coordinate for y-bar tensions; 9. the number of increments specified are greater than the dimensioned storage the program can operate with; and 10. misuse of the selected output option.

Computer Results. All input data cards are reflected in the printout of results exactly as they were input. It is good practice to again check these data for possible errors prior to inspection of the remainder of the results. The importance of using descriptive alphanumeric information for the problem series header cards and for each problem number card cannot be over-emphasized. This will avoid confusion when running a large number of problems.

A continuation of Table B4 is printed after the normal Table B4 input which reflects the computed optional pavement stiffness constants. Appropriate quarter, half, and full values are generated for bending stiffnesses and the subgrade spring equivalent. Full values of twisting stiffness are computed for all the mesh areas of the slab. Reference to Figure A2 in the Guide for Data Input explains the different data types and their associated numbering systems.

Immediately after the echo print of load placements in Table B7, a summary of the applied load patterns is printed. This should be inspected to see if the total number of wheel loads and their algebraic sum are of the intended amounts. The number of pattern wheels which fall outside the slab boundaries and their algebraic sum are also printed for information.

Table B8 gives the complete printout of final results. If the option to delete Table B8 is exercised in Table B1, then only a single reference station is printed at or near the center of the slab. Again, the user is cautioned to use this option with discretion to avoid deleting significant results. Table B8 is arranged to give the x and y-joint coordinate, the transverse deflection at each joint (upward deflections are positive), the bending and twisting moments, the support reaction, the principal moment or stress and its direction. The tabulations are arranged in groups for each y-station. Output values of bending and twisting moments are given on a per unit width basis. Bending moments are positive for compression in the top of the plate or slab. The x-bending moments act in the x-direction and y-bending moments in the y-direction.

The per unit width x twisting moment is tabulated and is exactly equal to the y twisting moment with opposite sign. The x-twisting moment acts in the x-direction and is about the y-axis. Even though the input values of twisting stiffness were specified at each mesh, the output value of twisting moment is the average of four adjacent mesh areas and is therefore given at the joint. The user is cautioned that the output values of twisting moment along the edges or other discontinuities of a slab or plate reflect the average and therefore may be a one-quarter, one-half, or some other proportionate value of twisting moment.

The support reaction is the concentrated value of resistance to displacement offered by any support springs if present. A subgrade modulus spring will reflect the concentrated value of pressure under the slab. The value of support reaction is different than the similar value tabulated in prior versions of DSLAB and SLAB computer programs. In those programs, the value might have been better labeled Net Reaction, or Net Force, since it was the summation of the applied load and support reaction.

Internally in the program, a Mohr's circle analysis is made at each joint using the orthogonal bending moments and the twisting moments to yield the larger numeric value (positive or negative) of principal moment per unit width and the angle from the x-axis of the coordinate system to the acting direction of this larger value. Counterclockwise angles are positive. If the stress option is specified in Table B1, the values are converted to the larger numeric value of principal stress instead of moment. A positive stress indicates tension in the bottom of the slab. The input value of thickness is properly

used only for slabs of constant thickness. For slabs of variable stiffness and thickness, a direct conversion can be made for principal stress from the principal moment.

As both a check on the internal computer solution and a check on the input of the load system to a problem, a statics check is printed at the end of Table B8 which is the algebraic sum of all the reaction values and should be equal to the sum of all the applied loads from Tables B4 and B7. This check should always be inspected to verify that the desired load system was specified and that the problem was properly solved.

Table B9 has been found to be the most immediately useful type of output in the SLAB 30E program. It lists the output parameters which were specified as selected output in Table B3. Each area of Table B3 is treated as a separate output array for each of the four desired output values of deflection, bending moments in the X and Y directions, and principal moment or stress depending on the Table B1 stress option.

The coordinate references are printed in consecutive groups associated with the largest number of increments in the rectangular area. For instance, if an area were desired from 10, 15 to 12, 20 then there would be three groups of values each with five values. If the area is square, then the groups are for each Y value included which is the same as the normal arrangement of Table B8 output. Adjacent to the coordinate is the numerical value of the deflection, moment, etc. To the right of the output values is a series of asterisks which have a relative placement to one another which are proportional to the numerical output value. Thus, a crude plot of the output values is obtained. The plot has a width of 20 printer characters and a length equal to the number of nodes encompassed by the area specified. The plot has no scale and no zero, the values are relative to one another, increasing positively to the right. The 20 character width is based on the minimum and maximum value in the area to be plotted. The user is cautioned to not misinterpret apparent changes in plot curvatures which might have been generated due to very slight numerical change.

The plots have been found to be especially valuable in understanding slab behavior in areas adjacent to concentrated wheel loads. All deflection areas are printed first followed by bending moment areas which are printed adjacent to each other if both x and y-moments were desired in the same area. The final selected output is for the principal moments or stresses. Plots of principal stresses along slab lines are somewhat misleading since the direction of the stress usually varies along the line. It is valuable, however, in pointing out maximum values of stress which might be overlooked when inspecting a mass of numbers in the normal Table B8 output.

The final printed output is of the computer time which has been used for the problem plus another time which is the total elapsed time. The user should record his problem run times for parent and offspring problems for each different problem size he runs. By this means, an estimate of required run times can be made for future problems. For small problems, the offspring times will be from 20 to 50 percent of the parent problem times. Fortunately, the offspring problem time decreases to a very small proportion of the parent problem time as the problem size becomes large. A time as low as four percent is possible. For this reason, the user should, for computer economy, run as many offspring problems for each parent problem as he thinks he might need.

Computer Time Requirements. The computer time required for running problems with program SLAB 30E cannot be as precisely defined as the storage requirements indicated in Figure A1. As previously stated, it would be good practice for the user to record run times as he uses the program to be able to make better run time predictions.

Based on a small sample of run times using SLAB 30E and similar programs, the following time expressions were derived:

For parent and independent problems,

$$T_p = \frac{2X^2Y}{1000}\left(1 + \frac{X}{50}\right) \qquad \text{[Eq A2]}$$

Where T_p is the predicted central processor time in seconds, and X and Y are the number of slab increments.

For offspring problems,

$$T_o = T_p\left(\frac{60 - X}{100}\right) \qquad \text{[Eq A3]}$$

where T_o is the offspring time and T_p is the above parent problem time. A minimum of four percent of T_p should be reserved for T_o times for large problems.

In both parent and offspring problems, a very rough estimate of input-output time required may be found by this expression:

$$T_{I/O} = \frac{XY}{5} \qquad \text{[Eq A4]}$$

where $T_{I/O}$ is the estimate of input-output time in seconds.

The above time estimates should be reasonably accurate for problems with X less than 30. For larger problems, the estimated times will probably be somewhat conservative.

The program compile time must be added to the estimated problem run times. The complete program deck will compile in approximately ten seconds. If stored on tape in a re-locatable form, the compile time will be nominal.

Sample Problems.

Bridge Approach Slab-Problem 601M. This problem is the same as example problem 601 of Stelzer and Hudson's report[13] and similar to problem 601 of Hudson and Matlock's report.[14] It is discussed here to demonstrate the use of Program SLAB 30E and to give a reference solution for program checkout when necessary.

The problem is illustrated in Figure A5. A 10-inch-thick, reinforced-concrete bridge approach slab is used. It is supported on one end by the bridge abutment; the other end rests on the embankment. Because of poor compaction, which often results when there is backfill, the soil has settled under the interior of the slab and left a section unsupported. The slab has a center-line joint and a crack which developed from a combination of shrinkage and previous overstress. For a non-uniformly supported slab such as this, the dead weight of the slab must be considered when evaluating moment and stresses. This weight acts as a uniform load of 600 lb per station. Two 10-kip wheel loads were considered in this example. An axial load of 5000 lb per in. has been induced by the expansion of the adjoining pavement.

The problem is modeled by a 12 by 16 increment slab. The slab stiffness options are exercised in Table B1. The subgrade is introduced in Table B4 over the proper area from stations 0, 7 to 12, 15. The crack and joint are modeled by subtracting the full bending stiffness along their lines from 0, 7 to 12, 7 and 6, 0 to 6, 16. The abutment support is simulated by a double line of rigid supports along that edge from 0, 0 to 12, 1. The loads are introduced by Tables B6 and B7 to demonstrate their use, although they could have been coded in Table B4. It will be noted that there are two load patterns in Table B6 which simulate a truck and trailer. The load placement in Table B7 is such that only two of the trailer wheels fall on the approach slab in the same position as shown on Figure A5.

The reader will note that the computed results are slightly different than Stelzer indicates. This is due to a coding error in his problem. The illustration of Figure A5 shows an axial compression of 5000 lb/in. in the y-direction of the slab, but the problem as coded in the Stelzer report has this axial compression in the x-direction. The thrust is slight and has little effect on the results in either case however.

The results for problem 601M are also somewhat misleading near the face of the abutment. A double line of rigid supports was used to represent the abutment support which effectively fixes the slab against rotation at that end. A more realistic modeling would have been achieved by a single line of supports at the abutment edge, thus allowing rotation to occur. The amount of nominal anchorage that is usually placed between slab and abutment is not nearly enough to preclude rotation.

Taxiway Slab with C-5A—Problem JR5. This and the next problem show how the application of Tables B6 and B7 can be used to conveniently code complex load patterns and their placements. The problem is illustrated in Figure A6 with the heavy crosses indicating the C-5A wheel loads, and the

[13] C. F. Stelzer and W. R. Hudson, *A Direct Computer Solution for Plates and Pavement Slabs*, Research Report 56-9 (Center for Highway Research, University of Texas, 1967).

[14] W. R. Hudson and Hudson Matlock, *Discontinuous Orthotropic Plates and Pavement Slabs*, Research Report 56-6 (Center of Highway Research, University of Texas, 1966).

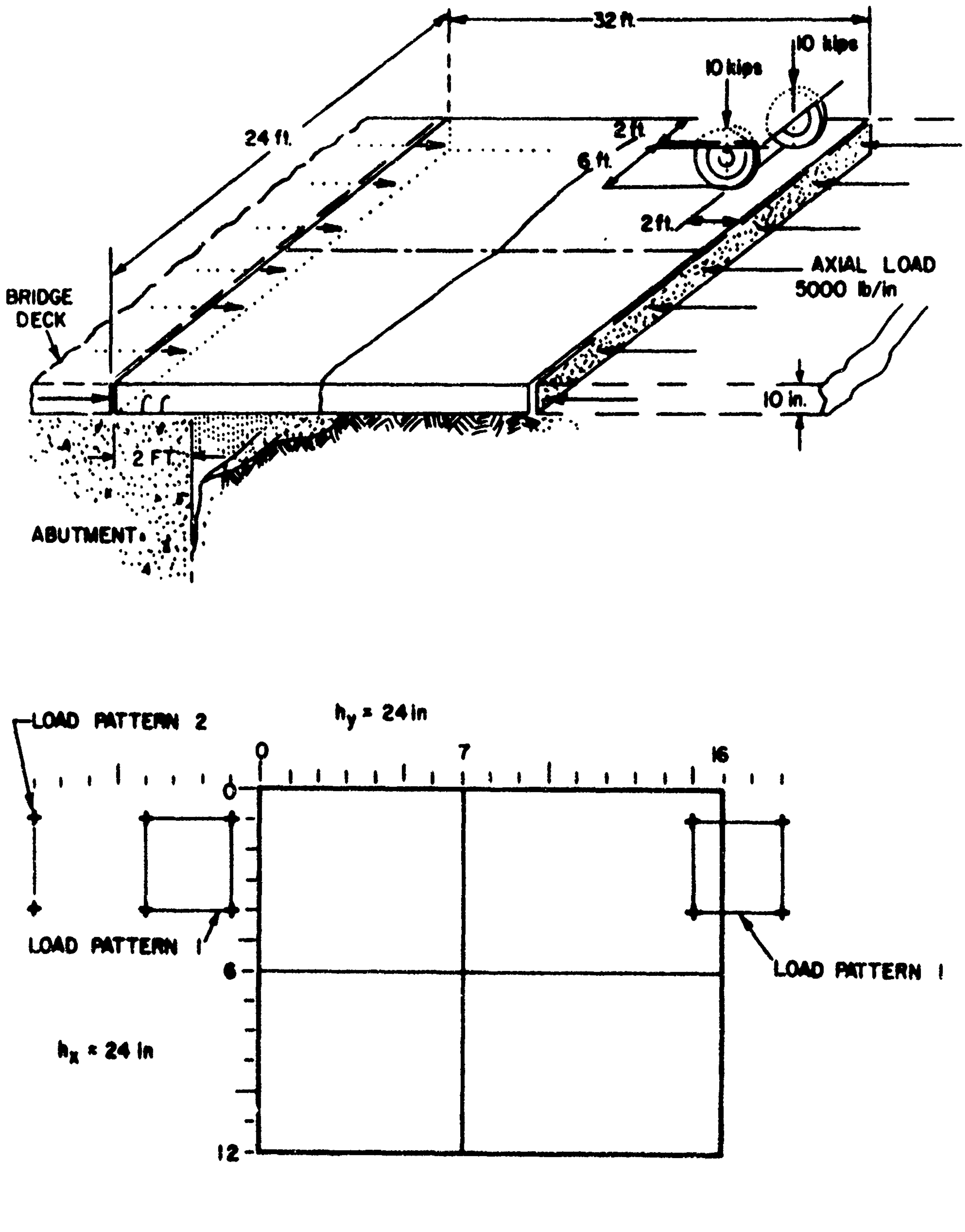
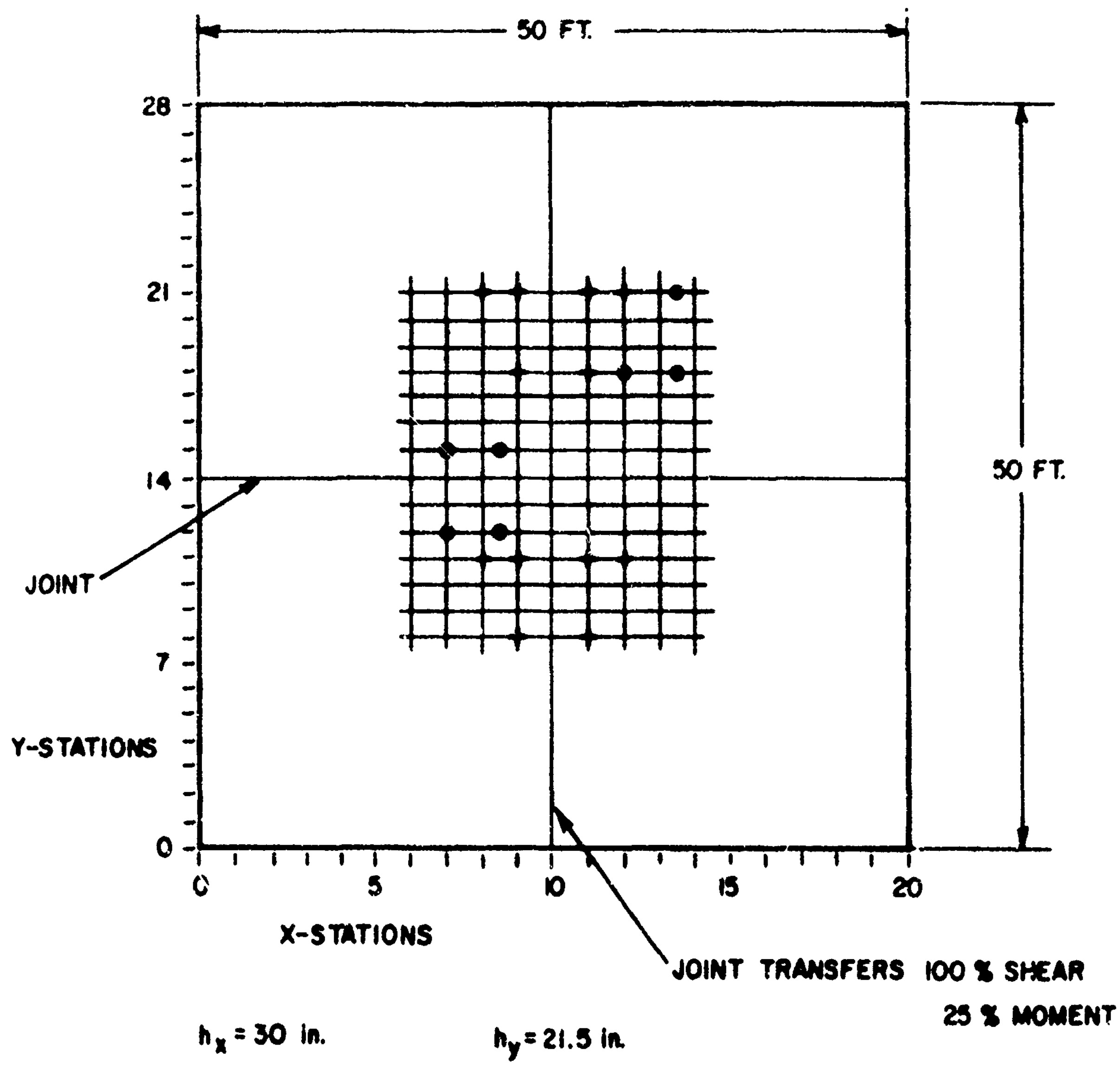


Figure A5. Bridge approach slab - problem 601M.



+ C-5A wheel load at 30,000 lbs (Prob JR5)

o 747 wheel load at 42,500 lbs (Prob JR6)

Thickness $t = 12$ in.

Subgrade $k = 125$ pci

Concrete $E = 5 \times 10^6$ psi

Concrete $\nu = 0.2$

Figure A6. Runway slab with C-5A and B-747—sample problems JR5 and JR6.

darkened circles the Boeing 747 loads which are used in the following problem.

The slab area under study has four 25-foot square panels with cracks between the panels that have 25 percent flexural stiffness remaining. The slab is 12 inches thick, the subgrade modulus is 125 lbs per cubic in., and the concrete modulus of elasticity is five million lbs per square in. with a Poisson's ratio of 0.2.

The selected increment lengths of 30 in. and 21.5 in. are coarse for a problem of this type, and the user would probably use more increments to effectively model his problem. However, a coarse solution when inspected would allow the user to then possibly delete, for additional finer mesh problems, areas of the slab which obviously do not affect the area under study.

All the input and output options are specified in Table B1. A selected output area which includes the loaded area of the slab is specified in Table B3. In addition, three lines of selected output are specified in the x and y-directions. Seventy-five percent of the slab bending stiffness is removed by Table B4 input along the lines of the joint. It is noted that this is accomplished by removing 37.5 percent along the complete line and the remaining 37.5 percent at the interior stations along the joint. By this means, the removed stiffness at the edges is compatible with the automatically generated half-values at the edges. One six-wheel gear group of the C-5A is described in Table B6 with an additional reference wheel at the center of the pattern with a zero load value. This pattern is then placed twice by Table B7 to create the total load pattern as shown on Figure A6.

The output of Table B8 has been omitted. The output of Table B9 indicates that the maximum deflection occurs at station 10, 10 and the maximum stress occurred at station 9, 11. The large slab area specified in Table B3 from 3, 8 to 17, 21 allows these maximums to be immediately discerned by the relative plot values adjacent to the tabulated values. Three additional lines of selected output were specified by Table B3 which coincide with some of the wheel loads as shown on Figure A6. These lines are valuable for comparing deflection and moment variations in specific directions or areas. It may be noted that the plotted output from areas can be thought of as plots of contiguous strips with the relative values of each line in proper proportion to adjacent lines. Variations of deflection, stress, or bending moment may thus be studied in one direction along consecutive strips taken in the other direction, but still allow the maximums to be emphasized by the plots.

Taxiway Slab with B-747—Problem JR6. This problem is the same slab shown in Figure A3 which was used for Problem JR5. A different load pattern is used which represents two gear groups of the Boeing 747 aircraft. Due to the modeling coarseness of this demonstration example, two wheels of each group are split to adjacent node points, thus forming a six-wheel group for each pattern. This apportionment must be taken into consideration when interpreting the results.

This problem is run as an offspring problem to the previous problem. Only Tables B1, B3, B6 and B7 were input. The pattern could have been described as pattern No. 2 in the previous problem and then simply placed by the Table B7 of this problem. The computer efficiency of multiple loadings via offspring problems may be seen by comparison of the run time of 23 seconds in Problem JR5 to 7 seconds in this problem which is 30 percent of the parent problem time. For extremely large problems (which might be a maximum of 68 by 68 or 20 by 342 as seen in Figure A1) the offspring time might be as little as 3 to 4 percent of the parent problem's time. A procedure for estimating computer times was given in the discussion of the program.

The output for this problem may be compared to that of Problem JR5. The major bending moments with the B-747 loads, even though the individual wheels are of almost 50 percent greater magnitude, are not 50 percent greater. When the stresses (or principal moments) are compared, however, the B-747 maximum is significantly higher than the stress induced by the C-5A. This is due to the much higher twisting moments present which are evidently caused by the influence of the two gear patterns on each other. The two C-5A patterns are orthogonal to the major slab directions, but the two B-747 patterns are oriented almost at 45 degrees to each other in relation to the major slab directions, thus causing a significant twisting effect.

Simply Supported Plate—Problem SAC1. This problem is added for reference and to roughly demonstrate the accuracy of the program. The prob-

lem is a simply supported isotropic plate 48 inches square, 0.9788 inches thick, with a concentrated load of 10^5 pounds at the center The optional stiffness input was not used, although it could have been. The stiffnesses entered in Table B4 are computed from the above plate thickness for a modulus of elasticity of 3.0×10^7 lbs/in^2, and a Poisson's ratio of 0.25. The simple supports are created by very stiff support springs around all edges.

The results indicate a maximum deflection at the center of 1.138 inches. Even though this is a coarse mesh of only 8 by 8 increments, the deflection is seen to agree closely with a closed-form solution of 1.07 inches given by Timoshenko.

This problem is recommended to be run for quick program checkout whenever it becomes necessary. An 8 by 8 driver for the program will only require approximately 24,000 (56,000 octal) words of storage and the problem will run in about 12 (14 octal) seconds which includes 10 seconds for a complete recompilation.

APPENDIX B GUIDE FOR DATA INPUT

SLAB 30E GUIDE FOR DATA INPUT CARD FORMS

IDENTIFICATION OF RUN (two alphanumeric cards per run)

1–80

IDENTIFICATION OF PROBLEM (one card for each problem; program stops if PROB NUM is left blank)

PROB NUM (1–5)	Description of problem (alphanumeric) (11–80)

Table B1. CONTROL DATA (one card for each problem).

Multiple Load Option +1 for Parent probs −1 for Offsprings	Number of Cards for Table 2	3	4	5	6	7	Optional Stiffness Input Constants Enter 1 to compute D^x & D^y	C	S	Options (1 = Yes) Delete Detailed Output	Print Principal Stress
5	20 *	25	30	35 *	40	45	55 **	60 **	65 **	75	80

Table B2. CONSTANTS (one card, omit for offspring problems).

Num Incrs X	Y	Increment Lengths X-Direction h_x	Y-Direction h_y	Poisson's Ratio ν	Modulus of Elasticity E	Slab Thickness t	Subgrade Modulus k
5	10	20	30	40	50	60	70
		L	L	–	F/L^2	L	F/L^3

(Modulus of Elasticity, Slab Thickness and Subgrade Modulus: Data for Optional Stiffness Constant)

F = Force Units, L = Length Units. All units must be consistent

Table B3. SPECIFIED AREAS FOR SELECTED OUTPUT (number of cards as shown in Table B1 10 maximum)

From X	Y	Through X	Y	PRINT and SPLOT (1 = Yes) DEFL	X-MOM	Y-MOM	PRIN STRESS/MOMENT
5	10	15	20	25	30	35	40

Table B4. STIFFNESS AND LOAD DATA (number of cards as shown in Table B1 enter only load for offspring problems)

From X	Y	Through X	Y	Bending Stiffness D^x	D^y	Load Q	Spring S	Twisting Stiffness C
5	10	15	20	30	40	50	60	70

*For offspring problems Tables B2 and B5 must be omitted, and only load may be entered in Table B4. Tables B3, B6 and B7 may be used as desired.

**Optional Stiffness Switches must be blank for offspring problems

Table B5. AXIAL THRUST DATA (number of cards as shown in Table B1 omit for offspring problems).

From X	From Y	Through X	Through Y		Axial Thrust px	Axial Thrust py
5	10	15	20	61	70	80

Table B6. SPECIAL LOAD PATTERNS (number of cards as shown in Table B1 up to 9 patterns may be used).

These coordinates refer to the load pattern

Pattern Num	Num of Loads in Pattern	x (Reference Load)	y	x	y	x	y	x	y	x	y	x	y	x	y	x	y	x	y	x	y	x	y
2	6	11	14	17	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	65	68	71	74	77	80

Magnitude of Loads

14	20	26	32	38	44	50	56	62	68	74	80

Special Patterns are placed as specified in Table B7. Up to 9 different patterns (18 cards) may be used. The first load of each pattern is the reference for Table B7; it may have a zero load magnitude. Negative pattern coordinates are permissable.

Table B7. PLACEMENTS OF TABLE B6 LOAD PATTERNS (number of cards as shown in Table B1).

Pattern Num	Num of Placements	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

These coordinates refer to the coordinate system defined by Table B2. Negative coordinate placements are permissable.

GENERAL PROGRAM NOTES

The data cards must be assembled in proper order for the program to run.

A consistent system of units must be used for all input data, for example, kips and feet.

All 2 to 5-space words are understood to be right-justified integers . . . . $\boxed{+4321}$

All 10-space words are floating-point numbers (E10.3) . . . . $\boxed{-4.321E+03}$

All 6-space words are floating-point numbers (F6.0) . . . . $\boxed{-30.0}$

Table B1. CONTROL DATA.

The multiple load option is exercised for problem series in which only the load positions and magnitudes of Tables B4 or B6 and B7 will vary. The first problem in a series is the Parent and is specified by entering +1, successive loadings are the Offspring and are specified by entering −1. If the option is left blank, the problem is complete within itself.

The number of cards input for Table B2 through Table B7 should be carefully checked after coding is completed. A checklist for allowable Tables and numbers of cards for each Table is given in Table A1.

Conventional plate or slab input stiffness may be selected by entering 1 for those to be computed. Appropriate values must then be made available in Table B2.

Output options may also be selected if desired. All detailed output of Table B8 may be suppressed except a single reference location at the center of the slab. The user may also print principal bending stresses computed from a constant thickness t in place of principal moment. The stress has the same sign as the principal moment. A value of thickness must then be available in Table B2.

Table B2. CONSTANTS.

Variables	h_x	h_y	ν	E	t	k
Typical Input Units:	in.	in.	none	lbs/in^2	in.	lbs/in^3

Only one card is needed for Parent or Independent problems. This table is omitted for Offspring problems.

Poisson's ratio will be taken as zero unless specified (always positive).

Data for computation of optional stiffnesses need be entered only if the options are exercised in Table B1. However, they may be entered and thus printed for reference if desired. The stiffnesses are computed from these customary relationships:

$$D^x = D^y = \frac{Et^3}{12(1-\nu^2)} \qquad C = \frac{Et^3}{12(1+\nu)} \qquad S = kh_xh_y$$

The computed stiffnesses are constant over the X by Y area of the slab and appropriate quarter and half-values are generated at corners and edges. They are printed as an extension to Table B2 and thus any additional stiffness values entered in Table B4 are superimposed algebraically.

Table B3. SPECIFIED AREAS FOR SELECTED OUTPUT.

A maximum of ten cards may be used, with a maximun of 300 points specified by each card.

The selected results are printed if any of the four print options are exercised.

Table B3 may be omitted if desired since all selected output values are duplicated in the complete printout of the results. The user is cautioned, however, that the complete printout may have been suppressed by the option in Table B1.

The selected output is controlled by the same joint coordinate system shown in Fig A2 and described below for Table B4.

Table B4. STIFFNESS AND LOAD DATA.

Variables:	D^x	D^y	Q	S	C
Typical Input Units:	$\frac{\text{lb-in}^2}{\text{in.}}$	$\frac{\text{lb-in}^2}{\text{in.}}$	lb	$\frac{\text{lb}}{\text{in.}}$	$\frac{\text{lb-in}^2}{\text{in/rad}}$

All data are described with a coordinate system notation which is related to the discrete-element model of the slab. This is shown in Figure A2.

To distribute data over a rectangular area, the lower left-hand and the upper right-hand coordinates must be specified. Figure A3 illustrates a sample data input.

All data entered in this table are algebraically added to the optional stiffness values generated from Tables B1 and B2.

To specify data at a single location, the same coordinates must be specified in both the "From" and "Through" columns.

The "Through" coordinates must always be equal to or numerically greater than the "From" coordinates.

The user may input values on the edges of the slab and the corners to represent the proportionate area desired as illustrated in Figure A3

There are no restrictions on the order of cards in Table B4. Cumulative input is used, with full values at each coordinate.

Unit stiffness values D^x and D^y are input at all joints. The values are reduced proportionately for edges.

Load values, Q, and support springs S for any joint are determined by multiplying the unit load or unit support value by the appropriate area of the real slab assigned to that joint. Hinged supports are provided by using large S values. Concentrated loads that occur between joints can be proportioned geometrically to adjacent joints.

Unit twisting stiffness C is defined for the mesh of the plate or slab surrounded by four rigid bars and four joints. The mesh is numbered according to the joint number at the upper right corner of the mesh as shown in Figure A2.

Table B5. AXIAL THRUST DATA.

Variables	P^x	P^y
Typical Input Units	lb	lb

All data in this table are concentrated. Distributed data must be summed over the width of the increment involved. Proportionate values can be used along edges.

Axial tension (+) or compression (—) values P are specified for each x-bar or y-bar. There is no mechanism in the program to automatically distribute the internal effects of any externally applied axial loads.

The axial thrust P^x refers to the force in the x-bar in the x-direction. Since it is a bar value, no coordinate should be used which would specify a P^x value in a bar outside the real plate or slab. The bars are numbered according to the joint number as shown in Figure A2

Table B6. SPECIAL LOAD PATTERNS.

A maximum of 9 different patterns (18 cards) may be used with up to 12 loads in each pattern.

The first load entered in columns 9 through 14 is designated as the reference load for placement of the pattern by Table B7. It may have a zero value for convenience if desired.

The coordinates entered in this table refer to the relative positions of the loads within the pattern. This is illustrated by Fig A4. Coordinates may also have negative values if desired.

Special Load patterns need not be entered if they are the same as those in previous problems, however, additional patterns may be used. Any new patterns entered replace those with the same pattern number. All load patterns defined in previous problems, including previous Parent and Independent problems, are retained, and may then be used by specifying their placement in Table B7.

Table B7. PLACEMENTS OF TABLE B6 LOAD PATTERNS.

Each pattern defined by Table B6 may be placed at a number of different locations on the slab. Any patterns specified in previous problems may be also placed by this table; they need not be re-entered in this problem's Table B6. Pattern numbers must be unique throughout the series, however.

Placements of the reference load are by coordinates which are related to the overall system defined by Table B2. Placements outside the boundaries of the actual slab are permissable. Any loads of the pattern that thus fall off the slab are not included in the solution. For reference, however, a summation of all loads placed on and off the slab is given in the output of Table B7.

If only new patterns and placements are specified, and no stiffness data is changed in Tables B2, B4, or B5, then this problem is an offspring problem.

Table No.	Maximum No. of Cards	Parent or Independent Problems		Offspring Problems		
		Required	Optional	Required	Optional	Disallowed
B1	1	X		X		
B2	1	X				X
B3	10		X		X	
B4	no limit		X		X*	
B5	no limit		X			X
B6	18		X		X	
B7	no limit		X		X	

*Load Only

The user should also ensure that if Optional Stiffness Options are exercised in Table B1, that appropriate data is available in Table B2. He should also verify that if the Option to Delete Detailed Output is used, that sufficient output will be printed for areas specified in Table B3.

Figure B1. Checklist for input tables.

GLOSSARY OF NOTATION

```
C          NOTATION FOR SLAB 3CE
C
C          A( ,1)                 RECURSION COEFFICIENT                     17NO9
C          AA( ,1)                COEFF IN STIFFNESS MATRIX                 19APR
C          ALF                    ANGLE ON MOHRS CIRCLE                     17NO9
C          AM1( ,1)               RECURSION COEFFICIENT A( ,1) AT J-1       12NO9
C          AM2( ,1)               RECURSION COEFFICIENT A( ,1) AT J-2       12NO9
C          AN1( ), AN2( )         IDENTIFICATION AND REMARKS (ALPHA - NUM)  28DE7
C          AT( , )                TEMP STORAGE FOR A( ,1) RECURSION COEFF   12NO9
C          B( , )                 RECURSION COEFFICIENT                     12NO9
C          BB( ,3)                COEFFS IN STIFFNESS MATRIX                03JA8
C          BETA                   HALF THETA (COUNTER CLOCKWISE IS +)       17NO9
C          BMA                    AVERAGE OF X AND Y BENDING MOMENTS        28DE7
C          BMO                    FIRST PRINCIPAL BENDING MOMENT            03JA8
C          BMP                    BMX - BMA                                 28DE7
C          BMR                    RADIUS OF MOHRS CIRCLE                    28DE7
C          BMT                    SECOND PRINCIPAL BENDING MOMENT           03JA8
C          BMX( , )               BENDING MOMENT IN THE X DIRECTION         03JA8
C          BMY( , )               BENDING MOMENT IN THE Y DIRECTION         03JA8
C          BM1( , )               RECURSION COEFFICIENT B( , ) AT J-1       12NO9
C          BM2( , )               RECURSION COEFFICIENT B( , ) AT J-2       12NO9
C          C( , )                 RECURSION COEFFICIENT                     12NO9
C          CC( ,5)                COEFFS IN STIFFNESS MATRIX                03JA8
C          CH( , )                TWISTING STIFFNESS PER  UNIT WIDTH        05JE8
C          CHN                    INPUT VALUE OF TWISTING STIFFNESS         05JE8
C          CM1( , )               RECURSION COEFFICIENT C( , ) AT J-1       12NO9
C          CM2( , )               RECURSION COEFFICIENT C( , ) AT J-2       12NO9
C          CRD( )                 CROSS BENDING STIFFNESS FOR PR EFFECTS    30JL8
C          D( , )                 RECURSION MULTIPLIER                      12NO9
C          DD( ,3)                COEFFS IN STIFFNESS MATRIX                03JA8
C          DX( , ) , DY( , )      BENDING STIFFNESSES PER UNIT WIDTH        28DE7
C          DXN , DYN              INPUT VALUES OF BENDING STIFFNESSES       03JA8
C          E( )                   RECURSION MULTIPLIER                      12NO9
C          EE( )                  COEFF IN  STIFFNESS MATRIX                03JA8
C          ER                     A TEST TO ELIMINATE REMNANT REACTIONS     28DE7
C          FF( )                  COEFF IN LOAD VECTOR                      03JA8
C          HX                     INCREMENT LENGTH IN X DIRECTION           03JA8
C          HXDHY                  HX DIVIDED BY HY                          28DE7
C          HXDHY3                 HX DIVIDED BY HY CUBED                    28DE7
C          HY                     INCREMENT LENGTH IN Y DIRECTION           28DE7
C          HYDHX                  HY DIVIDED BY HX                          28DE7
C          HYDHX3                 HY DIVIDED BY HX CUBED                    28DE7
C          I                      STATION NUMBER IN X DIRECTION             28DE7
C          IN1                    INITIAL EXTERNAL X COORDINATE             03JA8
C          IN2                    FINAL EXTERNAL X COORDINATE               28DE7
C          IN13( )                INITIAL EXTERNAL X COORDINATE IN TABLE 3  12NO9
C          IN23( )                FINAL EXTERNAL X COORDINATE IN TABLE 3    12NO9
C          IOPC                   TWISTING STIFFNESS(OPTIONAL) SWITCH       07SE0
C          IOPD                   BENDING  STIFFNESS (OPTIONAL) SWITCH      07SE0
C          IOPPS                  OPTION FOR PRIN STRESS INSTEAD OF MOM     07SE0
C          IOPS                   SUBGRADE MODULAS (OPTIONAL) SWITCH        07SE0
C          IOP8                   OPTION TO SUPRESS DETAILED OUTPUT (TAB 8) 07SE0
C          IOPP                   INTERNAL PLOT OPTION SWITCH               07SE0
C          ISTA                   EXTERNAL X COORDINATE NUMBER              12NO9
C          ITEST( )               ALPHANUMERIC BLANKS, USED TO TERMINATE    12NO9
C                                 THE PROGRAM                               12NO9
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C        I1 , I2              IN1 AND IN2 PLUS 2                         28DE7
C        J                    STATION NUMBER IN Y DIRECTION              28DE7
C        JJ                   J FOR SUBROUTINE MATRIX                    28DE7
C        JN1                  INITIAL EXTERNAL Y COORDINATE              28DE7
C        JN2                  FINAL EXTERNAL Y  COORDINATE               28DE7
C        JN13( )              INITIAL EXTERNAL Y COORDINATE IN TABLE 3   12NO9
C        JN23( )              FINAL EXTERNAL Y COORDINATE IN TABLE 3     12NO9
C        JSTA                 EXTERNAL Y COORDINATE NUMBER               12NO9
C        J1 , J2              JN1 AND JN2 PLUS  2                        28DE7
C        K                    DO LOOP INDEX USED INSTEAD OF I            03JA8
C        KASEX( )             OPTION FOR SELECTED PRINT OF BMX           12NO9
C        KASEY( )             OPTION FOR SELECTED PRINT OF BMY           12NO9
C        KLONG                MAXIMUM REAL Y DIMENSION SIZE              01AG8
C        KSHORT               MAXIMUM REAL X DIMENSION SIZE              01AG8
C        KML                  KEEP MULTIPLE LOADING FOR ERROR CHECKS     28DE7
C        KPROB( )             PROBLEM NUMBER FROM PARENT                 12NO9
C        LL                   DO LOOP INDEX FOR REVERSED J               03JA8
C        L2                   KLONG+3,  USED FOR VARIABLE DIMENSIONING   19APR
C        L1                   KSHORT+3, USED FOR VARIABLE DIMENSIONING   19APR
C        ML                   MULTIPLE LOADING SWITCH                    03JA8
C        MX                   NUMBER OF INCREMENTS IN X DIRECTION        28DE7
C        MXP1 THRU MXP5       MX + 1 THRU MX + 5                         01AG8
C        MY                   NUMBER OF INCREMENTS IN Y DIRECTION        28DE7
C        MYP1 THRU MYP5       MY + 1 THRU MY + 5                         01AG8
C        N                    INDEX FOR READING CARDS                    03JA8
C        NCT2                 NUMBER OF CARDS IN TABLE 2                 03JA8
C        NCT3                 NUMBER OF CARDS IN TABLE 3                 01AG8
C        NDE                  NUMBER OF DATA ERRORS                      03JA8
C        NPROB( )             PROBLEM NUMBER (PROG STOPS IF BLANK)       12NO9
C        ODHX                 ONE DIVIDED BY HX                          28DE7
C        ODHXHY               ONE DIVIDED BY HX TIMES HY                 28DE7
C        ODHX2                ONE DIVIDED BY HX SQUARED                  03JA8
C        ODHY                 ONE DIVIDED BY HY                          28DE7
C        ODHY2                ONE DIVIDED BY HY SQUARED                  03JA8
C        PDHXHY               POISSONS RATIO DIVIDED BY HX TIMES HY      28DE7
C        PMMAX                LARGEST PRINCIPAL MOMENT                   03JA8
C        PR                   POISSONS RATIO                             28DE7
C        PSIGO                PLOTTING ARRAY FOR PRIN STRESS OR MOMENTS  07SEC
C        PX( , ) , PY( , )    AXIAL TENSIONS IN X AND Y DIRECTIONS       01AG8
C        PXN , PYN            INPUT VALUES OF X AND Y AXIAL TENSIONS     01AG8
C        Q( , )               TRANSVERSE LOAD PER JOINT                  01AG8
C        QBMX , QBMY          LOAD ABSORBED IN BENDING                   01AG8
C        QN                   INPUT VALUE OF TRANSVERSE LOAD             03JA8
C        QPX , QPY            LAOD ABSORBED DUE TO AXIAL TENSIONS        01AG8
C        QTMX , QTMY          LOAD ABSORBED IN TWISTING                  01AG8
C        REACT                SUPPORT REACTION PER JOINT                 01AG8
C        S( , )               SPRING SUPPORT, VALUE PER JOINT            01AG8
C        SDT2                 MOMENT MULTIPLIER FOR PLATE STRESS         03JA8
C        SIGO                 LARGEST PRINCIPAL MOMENT OR STRESS         03JA8
C        SKK                  SUBGRADE MODULUS                           07SEC
C        SN                   INPUT VALUE OF SUPPORT SPRINGS             28DE7
C        SOM                  VARIABLE LABEL (=STRESS OR =MOMENT )       07SEC
C        SUMR                 SUMMATION OF REACTIONS FOR STATICS CHECK   03JA8
C        THETA                MOHRS CIRCLE ANGLE BETWEEN X AND           17NO9
C                             PRINCIPAL MOMENT                           17NO9
C        THK                  THICKNESS OF SLAB FOR STRESS CALCULATIONS  03JA8
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C         TGMX, TGMY          TEMP STORAGE ARRAYS FOR PLOT ROUTINE       07SEC
C         XX                  INDEPENDENT VARIABLE FOR PLOT ROUTINE      07SEO
C                                                                         7SEO
C         NOTATION FOR SUBROUTINE SPLOT 3 AND 4                          07SEO
C                                                                         7SEO
C         BETA                SCALED DATA ( FLT PT )                     07SEC
C         I                   GENERAL INDEX                              07SEC
C         IOTA                FIXED BETA                                 07SEO
C         IR                  POINT POSITIONER FOR PLOTTING STRING       07SEO
C         IS                  INDEX OVER X-STA TO BE PLOTTED             07SEC
C         ISKP                LENGTH OF SPACE ARRAY TO BE USED           07SEO
C         JS                  INDEX OVER J-STA TO BE PLOTTED             07SEC
C         L                   INDEX OVER ISKP                            07SEC
C         OMEGA               MAXIMUM VALUE IN X ARRAY                   07SEO
C         SIGMA               SCALER                                     07SEO
C         SPACE               INITIAL PART OF PLOTTING STRING            07SEO
C         SYMB( )             LAST 4 CHARACTERS OF PLOTTING STRING       07SEO
C         SYMD                SYMB(IR) - TEMP                            07SEO
C         THETA               MINIMUM VALUE IN X ARRAY                   07SEO
C         WIDTH               WIDTH OF PLOT IN CHARACTERS (COLUMNS)      07SEC
C         X                   ARRAY TO BE PLOTTED                        07SEO
```

LISTING OF PROGRAM DECK

```
      PROGRAM SLAB30E( INPUT, OUTPUT, TAPE1, TAPE2 )                    26JE0
C-----THIS PROGRAM IS A VERSION EXTENDED FROM SLAB 30 FOR CERL BY
C     AUSTIN RESEARCH ENGINEERS INC. IT HAS THE ADDED CAPABILITIES
C     SELECTED PLOT OUTPUT, PAVEMENT ORIENTED INPUT, AND THE
C     ABILITY TO INPUT A SPECIFIED PATTERN OF LOADS AT ANY DESIRED
C     LOCATION .
C
C-----FOR DIFFERENT SIZED PROBLEMS ONLY THE DIMENSION CARDS OF THIS
C     DRIVER NEED BE CHANGED.  FOR EXAMPLE,  AA(S+3,1) , BB(S+3,3) ,
C     ALSO CHANGE KSHORT AND KLONG TO EQUAL THE REAL X AND Y STATIONS.
C
C     CC(S+3,5) , B(S+3,S+3) , BMX(S+3,L+3)   WHERE S AND L REFER
C     TO THE SHORT AND LONG LENGTHS OF THE REAL PROBLEM.
C-----THIS PROGRAM IS NOW DIMENSIONED TO SOLVE A 20 BY  40 GRID.        RE-DIMEN
C
C
C-----THIS PROGRAM WILL OPERATE ON EITHER CDC6600 OR IBM360/50 SYSTEMS.
C     THOSE CARDS NEEDED TO OPERATE ON THE IBM360/50 ARE INCLUDED AS
C     FOLLOWING COMPANION CARDS TO THE CDC CARDS AND HAVE A C IN COLUMN
C     ONE AND THE SYMBOLS IBM IN COLUMNS 78 THRU 80. OTHER ADDITIONAL
C     CARDS SUCH AS THE SELECTIVE DOUBLE PRECISION STATEMENTS ARE ALSO
C     TAGGED WITH IBM AND NULLED WITH A C. WHEN CONVERTING TO THE
C     IBM360/50 SYSTEM, THE COMPANION CDC6600 CARDS SHOULD BE RETAINED
C     AND NULLED WITH AN ADDED C.
C
C     DOUBLE PRECISION  AA,     BB,    CC,     DD,   EE,     FF,     W,   26SE9IBM
C    1                   A,    AM1,   AM2,      B,  BM1,    BM2,   WP1,   26SE9IBM
C    2                   C,    CM1,   CM2,      D,    E,     AT,   WP2,   26SE9IBM
C    3                 ALF,   BETA,   BMA,    BMO,  BMP,    BMR,   BMT,   26SE9IBM
C    4                         CRD,                  ER,     HX, HXDHY,   26SE9IBM
C    5            HXDHY3,       HY, HYDHX,HYDHX3, ODHX,ODHXHY, ODHX2,   26SE9IBM
C    6            PDHXHY,       PI, PMMAX,     PR,                QBMX,   26SE9IBM
C    7                QBMY, REACT,  SDT2,   SIGO,           SUMR, THETA,   26SE9IBM
C    8                 THK,    THA,   TMX,    TMY,WSUM1, WSUM2, WSUM3,   26SE9IBM
C    9                         QPX,   QPY,  QTMX, QTMY                   26SE9IBM
      DIMENSION                      AA( 23 , 1  ),      EE( 23 , 1  ),  RE-DIMEN
     1         FF( 23 , 1  ),         A( 23 , 1  ),     AM1( 23 , 1  ),  RE-DIMEN
     2        AM2( 23 , 1  ),       WP1( 23 , 1  ),     WP2( 23 , 1  ),  RE-DIMEN
     3         BB( 23 , 3  ),        DD( 23 , 3  ),                      RE-DIMEN
     4        CC ( 23 , 5  ),                                            RE-DIMEN
     5          B( 23 , 23 ),       BM1( 23 , 23 ),     BM2( 23 , 23 ),  RE-DIMEN
     6          C( 23 , 23 ),       CM1( 23 , 23 ),     CH2( 23 , 23 ),  RE-DIMEN
     7          D( 23 , 23 ),         E( 23 , 23 ),                      RE-DIMEN
     8        BMX( 23 , 43 ),       BMY( 23 , 43 ),       Q( 23 , 43 ),  RE-DIMEN
     9          S( 23 , 43 ),        CH( 23 , 43 ),                      RE-DIMEN
     A         DX( 23 , 43 ),        DY( 23 , 43 ),      PX( 23 , 43 ),  RE-DIMEN
     B         PY( 23 , 43 ),         W( 23 , 43 ),      AT( 23 , 43 )   RE-DIMEN
      DIMENSION PSIGO (23,43)                                            RE-DIM
               KSHORT = 20                                               RE-DIMEN
               KLONG = 40                                                RE-DIMEN
               L1 = KSHORT + 3                                           05JA8
               L2 = KLONG + 3                                            05JA8
      CALL SB30ES          ( AA, BB, CC, DD, EE, FF,  A, AT, AM1,        26JE0
     1                     AM2,  B, BM1, BM2,  C, CM1, CM2,  D,   E,     05JA8
     2                     WP1, WP2, BMX, BMY, CH, PSIGO,DX, DY,   Q,    23JE0
     3                        S, PX, PY,  W, L1, L2               )     19APR
      END                                                                05JA8
```

```
      SUBROUTINE SB3CES ( AA, BB, CC, DD, EE, FF,  A, AT, AM1,  26JF0
     1                    AM2,  B, BM1, BM2,  C, CM1, CM2,  D,  E,  C5JA8
     2                    WP1, WP2, BMX, BMY, CH, PSIGO,DX,  DY,  Q,  23JF0
     3                      S, PX,  PY,  W,  L1,  L2              ) 19AP8
C
    1 FORMAT (   52H     PROGRAM  SLAB30E CERL SPECIAL DECK-ARE-JJP,FLE 26JE0
     1   ,                          28H  REVISION DATE 07 SEP 70    )REVISED
C
C     DOUBLE PRECISION  AA,     BB,     CC,     DD,    EE,     FF,     W,   26SE9IBM
C    1                   A,    AM1,    AM2,      B,   BM1,    BM2,   WP1,   26SE9IBM
C    2                   C,    CM1,    CM2,      D,     E,     AT,   WP2,   26SE9IBM
C    3                 ALF,   BETA,    BMA,    BMO,   BMP,    BMR,   BMT,   26SE9IBM
C    4                         CRD,                    ER,     HX, HXDHY,   26SE9IBM
C    5            HXDHY3,       HY, HYDHX,HYDHX3, ODHX,ODHXHY, ODHX2,   26SE9IBM
C    6            PDHXHY,       PI, PMMAX,    PR,                 QBMX,   26SE9IBM
C    7              QBMY, REACT,  SDT2,  SIGO,          SUMR, THETA,   26SE9IBM
C    8               THK,   TMA,   TMX,   TMY,WSUM1, WSUM2, WSUM3,   26SE9IBM
C    9                         QPX,   QPY,  QTMX, QTMY                  26SE9IBM
      DIMENSION                         AA( L1 , 1  ),      EE( L1 , 1  ),  05JA8
     1          FF( L1 , 1  ),       A( L1 , 1  ),     AM1( L1 , 1  ),  05JA8
     2         AM2( L1 , 1  ),     WP1( L1 , 1  ),     WP2( L1 , 1  ),  C5JA8
     3          BB( L1 , 3  ),      DD( L1 , 3  ),                      05JA8
     4          CC ( L1 , 5  ),                                         05JA8
     5           B( L1 ,L1  ),     BM1( L1 ,L1  ),     BM2( L1 ,L1  ),  19AP8
     6           C( L1 ,L1  ),     CM1( L1 ,L1  ),     CM2( L1 , L1 ),  19AP8
     7           D( L1 , L1 ),       E( L1 , L1 ),                      19AP8
     8         BMX( L1 , L2 ),     BMY( L1 , L2 ),       Q( L1 , L2 ),  19AP8
     9           S( L1 , L2 ),      CH( L1 , L2 ),                      07MY8
     A          DX( L1 , L2 ),      DY( L1 , L2 ),      PX( L1 , L2 ),  19AP8
     B          PY( L1 , L2 ),       W( L1 , L2 ),      AT( L1 , L2 )   31OC9
      DIMENSION                     IN13( 10      ),    JN13( 10      ),  03NO9
     1      IN23( 10      ),    JN23( 10      ),   KASEX( 10      ),  03NO9
     2     KASEY( 10      ),   NPROB(  2      ),   KPROB(  2      ),  03NO9
     3     ITEST(  2      ),    AN1( 40      ),     AN2( 18      ),  03NO9
     4       CRD(  5      )                                             03NO9
      DIMENSION  PSIGO ( L1 , L2 )                                      26JE0FN
      COMMON / SPLT / MX, MY, THK, NCT3, NDE, PR, SOM                   31AG0
      COMMON / CUPS /            EM, SKK, IOPD, IOPC, IOPS, HX, HY      17AG0
    6 FORMAT ( )                                                         4MY3
   10 FORMAT (     5H        , 80X, 10HI-----TRIM )                     03FE4
   11 FORMAT (     5H1       , 80X, 10HI-----TRIM )                     03FE4
   12 FORMAT ( 20A4 )                                                   17OC9
   13 FORMAT ( 5X, 20A4 )                                               17OC9
   14 FORMAT ( A1, A4, 5X, 17A4, A2 )                                   17OC9
   15 FORMAT (///10H     PROB , /5X, A1, A4, 5X, 17A4, A2 )             17OC9
   16 FORMAT (///17H     PROB (CONTD), /5X, A1, A4, 5X, 17A4, A2 )      17OC9
   19 FORMAT ( 6(/),44H   ***THIS SERIES OF PROBLEMS WAS RUN USING A    18AG0
     1         40H PROGRAM DEVELOPED FOR THE                            31AG0
     2   / 5X     52HTRANSPORTATION FACILITIES BRANCH,                  31AG0
     3   / 5X     52HDEPARTMENT OF THE ARMY,                            31AG0
     4   / 5X     52HCONSTRUCTION ENGINEERING RESEARCH LABORATORY,      31AG0
     5   / 5X     52HCHAMPAIGN, ILLINOIS                                31AG0
     6  //18X 10HBY                  //                                 07SE0
     7   /  5X    26HAUSTIN RESEARCH ENGINEERS,                         31AG0
     8   /  5X    20H       AUSTIN, TEXAS       )                       31AG0
```

```
   46 FORMAT (5X, 2(1X,I2,1X,I3),22X,E11.3)                             23OC7CDC
C  46 FORMAT (5X, 2(1X,I2,1X,I3),22X,1PE11.3 )                          17OC91BM
   47 FORMAT ( 5X, I2, 1X, I3, 6E11.3,      F6.1      )                 12DE7CDC
C  47 FORMAT ( 5X, I2, 1X, I3, 1P6E11.3,   0PF6.1 )                     17OC91BM
   48 FORMAT(      52H                X MOMENT AND X TWISTING MOMENT ACT IN04NO9
     1            32H THE X DIRECTION (ABOUT Y AXIS),    ,/,            04NO9
     2            50H                Y TWISTING MOMENT = -X TWISTING MOM 04NO9
     3            35HENT, COUNTERCLOCKWISE BETA ANGLES  ,/,             04NO9
     4            50H                ARE POSITIVE FROM X AXIS TO THE DIR 04NO9
     5            28HECTION OF LARGEST PRINCIPAL  , A6           )      18AG0
   49 FORMAT (///50H      *** THE DETAILED OUTPUT HAS BEEN DELETED BY T  18AG0
     1            21HHE OPTION IN TABLE 1.                              18AG0
     2 /, 9X      50HA SINGLE SET OF VALUES IS PRINTED AT OR NEAR THE S  07SE0
     3            25HLAB CENTER FOR REFERENCE    //  )                  07SE0
   50 FORMAT (///50H      STATICS CHECK.         SUMMATION OF REACTION, 12DE7
     1             6HS =    , E10.3  )                                  25JA8CDC
C    1             6HS =    , 1PE10.3 )                                 17OC91BM
   55 FORMAT ( //44H      TABLE 3.  SPECIFIED AREAS FOR SELECTED        04NO9
     1            15HPLOTTED OUTPUT       ,//                           26JE0
     2            45H                         PLOT  (1=YES)             26JE0
     3   /        45H        FROM    THRU        DEFL        X-MOMENT   17AG0
     4     1X     18H  Y-MOMENT   PRIN , A6 )                           17AG0
   60 FORMAT ( //35H      TABLE 6. SPECIAL LOAD PATTERNS//)             26JE0
   63 FORMAT ( //40H      TABLE 9.  SELECTED OUTPUT                  )  26JE0
   64 FORMAT ( //47H      TABLE 9.  SELECTED OUTPUT           -- USING  26JE0
     1            32HSTIFFNESS DATA FROM PARENT PROB    , A1, A4   )    07SE0
   74 FORMAT ( //50H      TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS /)17AG0
   91 FORMAT (///30H      **** PROBLEM TERMINATED  , I4  ,              18DE7
     1            20H  DATA ERRORS ****   )                             18DE7
   92 FORMAT ( //51H      **** CAUTION.  MULTIPLE LOADING OPTION MISUSED 18DE7
     1            35H FOR THIS OR PRIOR PROBLEM ****      )             18DE7
   93 FORMAT (///38H      **** PROBLEM WILL BE TERMINATED.              29OC9
     1            40HTHE DIMENSION STORAGE IS TOO SMALL **** )          29OC9
   94 FORMAT ( ///47H     *** NO CARDS ALLOWED IN TAB 2 OR 5 FOR ML=-1  )17AG0
   95 FORMAT ( ///50H  ***  PRIOR PROBLEM IS NOT A PARENT ***          )17AG0
   96 FORMAT ( ///50H  ***  MY SHOULD NOT BE LESS THAN MX   ***        )17AG0
   97 FORMAT ( 60X50H ***ILLEGAL DATA INPUT ATTEMPTED IN OFFSPRING PROB)31AG0
   98 FORMAT (///40H      **** UNDESIGNATED ERROR STOP ****   )         18DE7
C
C-----PROGRAM AND PROBLEM IDENTIFICATION
C
            ITEST(1) = 1H                                               17OC9
            ITEST(2) = 4H                                               17OC9
            KML = 0                                                     15DE7
      READ  12, ( AN1(N), N = 1, 40 )                                   17OC9
      CALL TIC TOC (1)                                                  26SE6
 1010 READ  14,  NPROB, ( AN2(N), N = 1, 18 )                           17OC9
         IF ( NPROB(1) - ITEST(1) ) 1020, 1015, 1020                    02OC9
 1015    IF ( NPROB(2) - ITEST(2) ) 1020, 9990, 1020                    02OC9
 1020 PRINT 11                                                          26AG3
 1021 PRINT  1                                                          19MR5
      PRINT 13, ( AN1(N), N = 1, 40 )                                   17OC9
      PRINT 15, NPROB, ( AN2(N), N = 1, 18 )                            17OC9
      REWIND 1                                                          20OC7
      REWIND 2                                                          20OC7
            NDE = 0                                                     18DE7
```

```
C
C----- INPUT TABLE 1
C
      READ  20, ML, NCT2, NCT3, NCT4, NCT5, NCT6, NCT7, IOPD, IOPC,     02JL0
     1          IOPS, IOP8, IOPPS                                        17AG0
      PRINT 30, ML, NCT2, NCT3, NCT4, NCT5, NCT6, NCT7, IOPD, IOPC,     02JL0
     1          IOPS, IOP8, IOPPS                                        17AG0
          IF ( ML ) 62, 61, 61                                           07OC9
C
C----- INPUT TABLE 2
C
   61 READ  21, MX, MY, HX,HY,             PR,  EM, THK, SKK             17AG0
   62 PRINT 22, MX, MY, HX,HY,             PR,  EM, THK, SKK             17AG0
          IF ( ML.NE.-1 )      GO TO  69                                 17AG0
          IF ( NCT2 + NCT5 .NE. 0 )     PRINT 94                         17AG0
          IF ( NCT2 + NCT5 .NE. 0 )     NDE = NDE + 1                    17AG0
   69     IF ( KML ) 75, 70, 72                                          17AG0
   70     IF ( ML ) 71, 75, 75                                           15DE7
   71          NDE = NDE + 1                                             18DE7
      PRINT 95                                                           17AG0
          GO TO 75                                                       15DE7
   72     IF ( ML ) 75, 73, 73                                           15DE7
   73 PRINT 92                                                           15DE7
   75          KML = ML                                                  15DE7
          IF ( L1-3-MX ) 76, 77, 77                                      29OC9
   76 PRINT 93                                                           29OC9
               NDE = NDE + 1                                             29OC9
   77     IF ( L2-3-MY ) 78, 79, 79                                      29OC9
   78 PRINT 93                                                           29OC9
               NDE = NDE + 1                                             29OC9
   79     IF ( MX - MY ) 81, 81, 80                                      29OC9
   80          NDE = NDE + 1                                             18DE7
      PRINT 96                                                           17AG0
   81     IF ( HX * HY ) 82, 82, 83                                      29NO7
   82          NDE = NDE + 1                                             18DE7
   83     IF ( PR + THK ) 84, 85, 85                                     29NO7
   84          NDE = NDE + 1                                             18DE7
   85     CONTINUE                                                       29NO7
C
C-----COMPUTE FOR CONVENIENCE
C
          IF ( ML ) 136, 100, 100                                        29NO7
  100          MXP1 = MX + 1                                             29NO7
               MYP1 = MY + 1                                             29NO7
               MXP2 = MX + 2                                             08DE7
               MYP2 = MY + 2                                             29NO7
               MXP3 = MX + 3                                             08DE7
               MYP3 = MY + 3                                             08DE7
               MXP4 = MX + 4                                             08DE7
               MYP4 = MY + 4                                             08DE7
               MXP5 = MX + 5                                             08DE7
               MYP5 = MY + 5                                             08DE7
               ODHX = 1.0 / HX                                           14SE6
               ODHY = 1.0 / HY                                           14SE6
               ODHXHY = ODHX * ODHY                                      14NO7
               PDHXHY = PR * ODHXHY                                      14NO7
```

```
            ODHY2 = ODHY * ODHY                                    14NO7
            ODHX2 = ODHX * ODHX                                    14NO7
            HXDHY = HX * ODHY                                      14NO7
            HYDHX = HY * ODHX                                      14NO7
            HYDHX3 = HYDHX * ODHX2                                 14NO7
            HXDHY3 = HXDHY * ODHY2                                 14NO7
            KPROB(1) = NPROB(1)                                    17OC9
            KPROB(2) = NPROB(2)                                    17OC9
         DO 105  J = 1, MYP3                                       29NO7
         DO 103  I = 1, MXP3                                       29NO7
            DX(I,J) = 0.0                                          01NO6
            DY(I,J) = 0.0                                          01NO6
             Q(I,J) = 0.0                                          01NO6
             S(I,J) = 0.0                                          01NO6
            CH(I,J) = 0.0                                          07MY8
            PX(I,J) = 0.0                                          23JE7
            PY(I,J) = 0.0                                          23JE7
            BMX(I,J) = 0.0                                         29NO7
            BMY(I,J) = 0.0                                         29NO7
  103    CONTINUE                                                  29NO7
  105    CONTINUE                                                  23JE7
         DO  135  K = 1, MXP3                                      29NO7
         DO  130  I = 1, MXP3                                      29NO7
            B(I,K) = 0.0                                           29NO7
            BM1(I,K) = 0.0                                         21DE7
            C(I,K) = 0.0                                           29NO7
            CM1(I,K) = 0.0                                         21DE7
  130 CONTINUE                                                     16AG7
  135 CONTINUE                                                     16AG7
  136    DO  138  K = 1, MXP3                                      29NO7
            A(K,1) = 0.0                                           21DE7
            AM1(K,1) = 0.0                                         29NO7
            W(K,MYP3) = 0.0                                        28DE7
            WP1(K,1) = 0.0                                         29NO7
            WP2(K,1) = 0.0                                         28DE7
  138    CONTINUE                                                  29NO7
C
C-----  INPUT TABLE 3
C
            SOM = 6HSTRESS                                         17AG0
         IF ( IOPPS.NE.1 )    SOM = 6HMOMENT                       17AG0
      PRINT 55 , SOM                                               17AG0
         IF ( NCT3 ) 9980, 180, 150                                24SE9
  150       IPOP = 0                                               26JE0
      CALL SLPLT  ( W, BMX, BMY, PSIGO, L1, L2, IPOP, 0 )          26JE0
         GO TO 181                                                 24SE9
  180 PRINT  36                                                    24SE9
  181    CONTINUE                                                  24SE9
C
C-----  INPUT TABLE 4
C
  190    IF ( ML ) 200, 320, 320                                   15DE7
  200 PRINT 34, KPROB                                              15DE7
         DO  220  J = 1, MYP3                                      15DE7
         DO  210  I = 1, MXP3                                      29NO7
            W(I,J) = 0.0                                           24OC7
```

```
             Q(I,J) = 0.0                                                 240C7
210      CONTINUE                                                         240C7
220      CONTINUE                                                         240C7
         IF ( NCT4 ) 9980, 224, 225                                       07SE0
224 PRINT 38                                                               7SE0
         GO TO  362                                                       07SE0
225      DO  260  N = 1, NCT4                                             02SE0
    READ 26 , IN1, JN1, IN2, JN2, ON                                      200C7
    PRINT 46, IN1, JN1, IN2, JN2, ON                                      200C7
             I1   =   IN1 + 2                                             29NO7
             J1   =   JN1 + 2                                             29NO7
             I2   =   IN2 + 2                                             29NO7
             J2   =   JN2 + 2                                             29NO7
         IF ( IN1 - IN2 ) 232, 232, 231                                   29NO7
231          NDE = NDE + 1                                                18DE7
232      IF ( JN1 - JN2 ) 234, 234, 233                                   29NO7
233          NDE = NDE + 1                                                18DE7
234      IF ( IN2 - MX ) 236, 236, 235                                    29NO7
235          NDE = NDE + 1                                                18DE7
236      IF ( JN2 - MY ) 238, 238, 237                                    29NO7
237          NDE = NDE + 1                                                18DE7
238      DO  255  I = I1, I2                                              29NO7
         DO 250  J = J1, J2                                               200C7
             Q(I,J) = Q(I,J) + QN                                         200C7
250      CONTINUE                                                         200C7
255      CONTINUE                                                         200C7
260      CONTINUE                                                         200C7
         GO TO 386                                                        19DE7
320 PRINT 33                                                              15DE7
         IF ( NCT4 ) 9980, 323, 325                                       02SE0
323 PRINT 38                                                               2SE0
         GO TO  362                                                       02SE0
325      DO  360  N = 1, NCT4                                             02SE0
    READ  23,  IN1, JN1, IN2, JN2, DXN, DYN, QN, SN, CHN                  07MY8
    PRINT 43,  IN1, JN1, IN2, JN2, DXN, DYN, QN, SN, CHN                  07MY8
         IF ( CHN        ) 331, 335, 331                                  07MY8
331      IF ( IN1 * IN2 * JN1 * JN2 ) 9980, 333, 335                      18DE7
333          NDE = NDE + 1                                                18DE7
335          I1   =   IN1 + 2                                             15DE7
             J1   =   JN1 + 2                                             29NO7
             I2   =   IN2 + 2                                             29NO7
             J2   =   JN2 + 2                                             29NO7
         IF ( IN1 - IN2 ) 342, 342, 341                                   29NO7
341          NDE = NDE + 1                                                18DE7
342      IF ( JN1 - JN2 ) 344, 344, 343                                   29NO7
343          NDE = NDE + 1                                                18DE7
344      IF ( IN2 - MX ) 346, 346, 345                                    29NO7
345          NDE = NDE + 1                                                18DE7
346      IF ( JN2 - MY ) 348, 348, 347                                    29NO7
347          NDE = NDE + 1                                                18DE7
348      DO  355  I = I1, I2                                              29NO7
         DO 350  J = J1, J2                                               01DE7
             DX(I,J) = DX(I,J) + DXN                                      4SE64
             DY(I,J) = DY(I,J) + DYN                                      4SE64
              Q(I,J) =  Q(I,J) +  QN                                      13AP3
              S(I,J) =  S(I,J) +  SN                                      13AP3
```

```
            CH(I,J) = CH(I,J) + CHN                                        07MY8
  350       CONTINUE                                                       13AP3
  355       CONTINUE                                                       22JE7
  360       CONTINUE                                                       13AP3
C       GENERATE EXTENDED TABLE 4
  362       IF ( IOPD+IOPC+IOPS .EQ. 0 )  GO TO  363                       26JF0
            IF ( ML.EQ.-1 )      PRINT 97                                  31AG0
            IF ( ML.EQ.-1 )      GO TO  363                                31AG0
        CALL COPS  ( CH, DX, DY, S, L1, L2 )                               26JE0
  363       CONTINUE                                                       26JE0
C
C----- INPUT TABLE 5
C
        PRINT 37                                                           22AP5
            IF ( NCT5 ) 9980, 385, 364                                     24SE9
  364       DO  382  N = 1, NCT5                                           24SE9
        READ  24,  IN1, JN1, IN2, JN2, PXN, PYN                            11DE7
        PRINT 44,  IN1, JN1, IN2, JN2, PXN, PYN                            11DE7
            IF ( PXN ) 365, 367, 365                                       18DE7
  365       IF ( IN1 * IN2 ) 9980, 366, 367                                18DE7
  366           NDE = NDE + 1                                              18DE7
  367       IF ( PYN ) 368, 370, 368                                       18DE7
  368       IF ( JN1 * JN2 ) 9980, 369, 370                                18DE7
  369           NDE = NDE + 1                                              18DE7
  370           I1  =  IN1 + 2                                             18DE7
                J1  =  JN1 + 2                                             29NO7
                I2  =  IN2 + 2                                             29NO7
                J2  =  JN2 + 2                                             29NO7
            IF ( IN1 - IN2 ) 372, 372, 371                                 29NO7
  371           NDE = NDE + 1                                              18DE7
  372       IF ( JN1 - JN2 ) 374, 374, 373                                 29NO7
  373           NDE = NDE + 1                                              18DE7
  374       IF ( IN2 - MX ) 376, 376, 375                                  29NO7
  375           NDE = NDE + 1                                              18DE7
  376       IF ( JN2 - MY ) 378, 378, 377                                  29NO7
  377           NDE = NDE + 1                                              18DE7
  378       DO  380  I = I1, I2                                            12DE7
            DO  379  J = J1, J2                                            12DE7
                PX(I,J) = PX(I,J) + PXN                                    20AP5
                PY(I,J) = PY(I,J) + PYN                                    20AP5
  379       CONTINUE                                                       29NO7
  380       CONTINUE                                                       12DE7
  382       CONTINUE                                                       12DE7
            GO TO 386                                                      19DE7
  385   PRINT 38                                                           15DE7
C
C----- INPUT TABLES 6 AND 7
C
  386   PRINT 60                                                           26JE0
            IF ( NCT7 ) 9980, 389, 388                                     31AG0
  388   CALL PLUP       ( C, L1, L2, NCT6, NCT7, MX, MY )                  26JE0
            GO TO  400                                                     26JE0
  389   PRINT 38                                                           17AG0
            IF ( NCT7 ) 9980, 392, 400                                     17AG0
  392   PRINT 74                                                           17AG0
        PRINT 38                                                           17AG0
```

```
                                                                26JE0
 400      IF ( NDE ) 9980, 401, 397                             26JE0
 397 PRINT 91, NDE                                              29N07
          GO TO 9990
C
C-----FORM SUB-MATRICES
C
C-----A SPRING IS PLACED AT PTS BEYOND BOUNDARIES OF THE REAL SLAB
C         TO MAKE SOLUTION OF NON-RECTANGULAR SLABS OR SLABS WITH
C         HOLES POSSIBLE. THIS IS DONE BY TESTING ON THE CC(I,3)
C         TERMS, AND IF ZERO, SET EQUAL TO 1.0
C
C-----Q(I,J) IS THE INPUT LOAD FOR THIS PROBLEM, OTHER PRIOR PROBLEM
C     LOADS ARE DISCARDED
C                                                               29N07
 401      DO  600  J = 1, MYP3                                  08DE7
          DO 404  I = 1, MXP3                                   30OC9
                FF(I,1) = Q(I,J)                                08DE7
          IF (J-1) 9980, 402, 403                               03JA8
 402            AA(I,1) = 0.0                                   08DE7
          GO TO 404                                             03JA8
 403            AA(I,1) = DY(I,J-1) * HXDHY3                    08DE7
 404      CONTINUE                                              08DE7
          IF ( ML ) 501, 405, 405                               08DE7
 405      DO 500  I = 1, MXP3                                   13DE7
          IF (J-1) 9980, 410, 407                               05N09
 407      IF (MYP3-J) 9980, 438, 420
C-----COEFFICIENTS COMPUTED AT J = 1                            08DE7
 410      IF (I-1) 9980, 411, 412                               08DE7
 411            BB(I,2)     = 0.0                               08DE7
                BB(I,3)     = 0.0                               17OC9
                CC(I,3)     = 1.0                               08DE7
                CC(I,4)     = 0.0                               08DE7
                CC(I,5)     = 0.0                               08DE7
                DD(I,2)     = 0.0                               08DE7
                DD(I,3)     = 0.0                               03JA8
                EE(I,1)     = 0.0                               08DE7
          GO TO 500                                             13DE7
 412      IF (MXP3-I) 9980, 419, 413                            29JL8
 413            CRD(5) = AMIN1 ( DX(I   ,J+1) , DY(I   ,J+1) )  29JL8
                BB(I,1)     = 0.0                               08DE7
                BB(I,2)     = 0.0                               08DE7
                BB(I,3)     = 0.0                               08DE7
                CC(I,2)     = 0.0                               08DE7
                CC(I,3)     = HXDHY3 * DY(I,J+1)                11DE7
     1                          + ODHY * PY(I,J+1)              14DE7
          IF ( CC(I,3) )  415, 414, 415                         17OC9
 414            CC(I,3)     = 1.0                               13DE7
 415            CC(I,4)     = 0.0                               29JL8
                DD(I,1)     = PDHXHY * CRD(5)                   08DE7
                DD(I,2)     = -2.0 * ( HXDHY3 * DY(I,J+1) -     29JL8
     1                          + PDHXHY * CRD(5) )             08DE7
     2                          - ODHY * PY(I,J+1)              29JL8
                DD(I,3)     = PDHXHY * CRD(5)                   03JA8
                EE(I,1)     = HXDHY3 * DY(I,J+1)                13DE7
          IF (I-2) 9980, 417, 416                               13DE7
 416            CC(I,1)     = 0.0
```

```
 417      IF (MXP2-I) 9980, 500, 418                                    13DE7
 418           CC(I,5)     = 0.0                                        13DE7
          GO TO 500                                                     08DE7
 419           BB(I,1)     = 0.0                                        13DE7
               BB(I,2)     = 0.0                                        08DE7
               CC(I,1)     = 0.0                                        08DE7
               CC(I,3)     = 1.0                                        17OC9
               CC(I,2)     = 0.0                                        08DE7
               DD(I,2)     = 0.0                                        08DE7
               DD(I,1)     = 0.0                                        08DE7
                 EE(I,1)     = 0.0
          GO TO 500                                                     08DE7
C-----COEFFICIENTS COMPUTED FROM J = 2 TO MYP2
 420      IF (I-1) 9980, 421, 424                                       05NO9
 421           CRD(3) = AMIN1 ( DX(I+1,J   ) , DY(I+1,J   ) )           29JL8
               BB(I,2)     = 0.0                                        29JL8
               BB(I,3)     = PDHXHY * CRD(3)                            29JL8
               CC(I,3)     = HYDHX3 * DX(I+1,J)                         08DE7
    1                          + ODHX * PX(I+1,J)                       08DE7
          IF ( CC(I,3) )  441, 422, 423                                 05NO9
 422           CC(I,3)     = 1.0                                        05NO9
 423           CC(I,4)     = -2.0 * (HYDHX3 * DX(I+1,J)                 05NO9
    1                          + PDHXHY * CRD(3) )                      29JL8
    2                          - ODHX * PX(I+1,J)                       08DE7
               CC(I,5)     = HYDHX3 * DX(I+1,J)                         11DE7
               DD(I,2)     = 0.0                                        08DE7
               DD(I,3)     = PDHXHY * CRD(3)                            29JL8
               EE(I,1)     = 0.0                                        03JA8
          GO TO 500                                                     08DE7
 424      IF (MXP3-I) 9980, 431, 425                                    05NO9
 425           CRD(1) = AMIN1 ( DX(I-1,J   ) , DY(I-1,J   ) )           05NO9
               CRD(2) = AMIN1 ( DX(I   ,J   ) , DY(I   ,J   ) )         29JL8
               CRD(3) = AMIN1 ( DX(I+1,J   ) , DY(I+1,J   ) )           29JL8
               CRD(4) = AMIN1 ( DX(I   ,J-1) , DY(I   ,J-1) )           29JL8
               CRD(5) = AMIN1 ( DX(I   ,J+1) , DY(I   ,J+1) )           29JL8
               BB(I,1)       = PDHXHY * ( CRD(1) + CRD(4) ) +           30JL8
    1                          ODHXHY * ( CH(I,J) + CH(I,J) )           07MY8
               BB(I,2)     = -2.0 * ( PDHXHY * ( CRD(2) + CRD(4) )      29JL8
    1                          + HXDHY3 * ( DY(I,J-1) + DY(I,J) ) )     14SE6
    2                          + ODHXHY * ( - CH(I,J) - CH(I+1,J)       07MY8
    3                          - CH(I,J) - CH(I+1,J) ) - ODHY * PY(I,J) 07MY8
               BB(I,3)       = PDHXHY * ( CRD(3) + CRD(4) )             29JL8
    1                          + ODHXHY * ( CH(I+1,J) + CH(I+1,J) )     07MY8
               CC(I,2)       = -2.0 * ( HYDHX3 * ( DX(I-1,J) + DX(I,J) ) 29NO7
    1                          + PDHXHY * ( CRD(1) + CRD(2) ) )         29JL8
    2                          + ODHXHY * ( - CH(I,J) - CH(I,J+1)       07MY8
    3                          - CH(I,J) - CH(I,J+1) ) - ODHX * PX(I,J) 07MY8
               CC(I,3)     = HYDHX3 * ( DX(I-1,J) + 4.0 * DX(I,J)       29NO7
    1                          + DX(I+1,J) ) + HXDHY3 * ( DY(I,J-1) + 4.014SE6
    2                          * DY(I,J) + DY(I,J+1) ) + PDHXHY * 4.0   14SE6
    3                          * ( CRD(2) + CRD(2) )   + ODHXHY         29JL8
    4                          * ( CH(I,J) + CH(I,J+1) + CH(I+1,J)      09MY8
    5                          + CH(I+1,J+1) + CH(I,J) + CH(I+1,J)      07MY8
    6                          + CH(I,J+1) + CH(I+1,J+1) ) + ODHX       07MY8
    7                          * ( PX(I,J) + PX(I+1,J) ) + ODHY         14SE6
    8                          * ( PY(I,J) + PY(I,J+1) ) + S(I,J)       14SE6
```

```
      IF ( CC(I,3) )  427, 426, 427                                    05NO9
426      CC(I,3)    = 1.0                                               05NO9
427      CC(I,4)       = -2.0 * ( HYDHX3 * ( DX(I,J) + DX(I+1,J) )     05NO9
   1                     + PDHXHY * ( CRD(3) + CRD(2) ) )               29JL8
   2                     + ODHXHY * ( - CH(I+1,J) - CH(I+1,J+1)         07MY8
   3                     - CH(I+1,J) - CH(I+1,J+1) ) - ODHX             07MY8
   4                     * PX(I+1,J)                                    14SE6
         DD(I,1)       = PDHXHY * ( CRD(1) + CRD(5) )                  29JL8
   1                     + ODHXHY * ( CH(I,J+1) + CH(I,J+1) )           09MY8
         DD(I,2)    = -2.0 * ( HXDHY3 * ( DY(I,J) + DY(I,J+1) )        29NO7
   1                     + PDHXHY * ( CRD(2) + CRD(5) ) )               29JL8
   2                     + ODHXHY * ( - CH(I,J+1) - CH(I+1,J+1)         07MY8
   3                     - CH(I,J+1) - CH(I+1,J+1) ) - ODHY             07MY8
   4                     * PY(I,J+1)                                    14SE6
         DD(I,3)       = PDHXHY * ( CRD(3) + CRD(5) )                  29JL8
   1                     + ODHXHY * ( CH(I+1,J+1) + CH(I+1,J+1) )       C7MY8
         EE(I,1)    = HXDHY3 * DY(I,J+1)                               03JA8
      IF (I-2) 9980, 429, 428                                          05NO9
428      CC(I,1)    = DX(I-1,J) * HYDHX3                               05NO9
429   IF (MXP2 - I) 9980, 500, 430                                     05NO9
430      CC(I,5)    = HYDHX3 * DX(I+1,J)                               05NO9
      GO TO 500                                                        08DE7
431      CRD(1) = AMIN1 ( DX(I-1,J   ) , DY(I-1,J   ) )                05NO9
         BB(I,1)    = CRD(1)     * PDHXHY                              29JL8
         BB(I,2)    = 0.0                                              08DE7
         CC(I,1)    = DX(I-1,J) * HYDHX3                               08DE7
         CC(I,2)    = -2.0 * ( HYDHX3 * DX(I-1,J)                      08DE7
   1                     + PDHXHY * CRD(1) )                            29JL8
         CC(I,3)    = HYDHX3 * DX(I-1,J)                               08DE7
      IF ( CC(I,3) )  436, 435, 436                                    05NO9
435      CC(I,3)    = 1.0                                              05NO9
436      DD(I,1)    = PDHXHY * CRD(1)                                  05NO9
         DD(I,2)    = 0.0                                              08DE7
         EE(I,1)    = 0.0                                              03JA8
      GO TO 500                                                        08DE7
C-----COEFFICIENTS COMPUTED AT J = MYP3
438   IF (I-1) 9980, 439, 440                                          05NO9
439      BB(I,2)    = 0.0                                              05NO9
         BB(I,3)    = 0.0                                              08DE7
         CC(I,3)    = 1.0                                              17OC9
         CC(I,4)    = 0.0                                              08DE7
         CC(I,5)    = 0.0                                              08DE7
         DD(I,2)    = 0.0                                              08DE7
         DD(I,3)    = 0.0                                              08DE7
         EE(I,1)    = 0.0                                              03JA8
      GO TO 500                                                        08DE7
440   IF (MXP3-I) 9980, 447, 441                                       05NO9
441      CRD(4) = AMIN1 ( DX(I   ,J-1) , DY(I   ,J-1) )                05NO9
         BB(I,1)    = CRD(4)     * PDHXHY                              29JL8
         BB(I,2)    = -2.0 * ( PDHXHY * CRD(4)                         29JL8
   1                     + HXDHY3 * DY(I,J-1) )                         08DE7
         BB(I,3)    = PDHXHY * CRD(4)                                  29JL8
         CC(I,2)    = 0.0                                              08DE7
         CC(I,3)    = HXDHY3 * DY(I,J-1)                               08DE7
      IF ( CC(I,3) ) 9980, 442, 443                                    05NO9
442      CC(I,3)    = 1.0                                              05NO9
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 443            CC(I,4)    = 0.0                                              05N09
                DD(I,1)    = 0.0                                              08DE7
                DD(I,2)    = 0.0                                              08DE7
                DD(I,3)    = 0.0                                              08DE7
                EE(I,1)    = 0.0                                              03JA8
          IF (I-2) 9980, 445, 444                                             05N09
 444            CC(I,1)    = 0.0                                              05N09
 445      IF (MXP2-I) 9980, 500, 446                                          05N09
 446            CC(I,5)    = 0.0                                              05N09
          GO TO 500                                                           08DE7
 447            BB(I,1)    = 0.0                                              05N09
                BB(I,2)    = 0.0                                              08DE7
                CC(I,1)    = 0.0                                              08DE7
                CC(I,2)    = 0.0                                              08DE7
                CC(I,3)    = 1.0                                              17OC9
                DD(I,1)    = 0.0                                              08DE7
                DD(I,2)    = 0.0                                              08DE7
                EE(I,1)    = 0.0                                              03JA8
 500      CONTINUE                                                            04MY7
C
C-----BEGIN MAIN SOLUTION
 501      DO  515  I = 1, MXP3                                                29N07
C-----RETAIN RECURSION COEFFICIENTS TO USE AT NEXT J STEP
                AM2(I,1) = AM1(I,1)                                           21DE7
                AM1(I,1) = A(I,1)                                             21DE7
 504      IF ( ML ) 515, 505, 505                                             29N07
 505      DO  510  K = 1, MXP3                                                20OC7
                BM2(I,K) = BM1(I,K)                                           21DE7
                BM1(I,K) = B(I,K)                                             21DE7
                CM2(I,K) = CM1(I,K)                                           21DE7
                CM1(I,K) = C(I,K)                                             21DE7
 510      CONTINUE                                                            04MY7
 515      CONTINUE                                                            30JE7
C-----SOLVE FOR ALL RECURSION COEFFICIENTS AND RETAIN THE A(I,1)
C         COEFFICIENT AT THIS J STEP IN THE AT(I,J) ARRAY
                JJ = J                                                        08AG7
      CALL MATRIX ( L1,JJ,MXP3,MY,AA,BB,CC,DD,EE,FF,A,AM1,                    29N07
     1                    AM2,B,BM1,BM2,C,CM1,CM2,D,E,ML   )                  19AP8
          DO 520  I = 1, MXP3                                                 20OC7
                AT(I,J) = A(I,1)                                              29N07
 520      CONTINUE                                                            20OC7
C
C-----TEST FOR MULTIPLE LOADING --
C         IF ZERO, RETAIN B AND C COEFFICIENTS ON TAPE 1.
C         IF PARENT, ALSO RETAIN D AND E MULTIPLIERS ON TAPE 2.
C         IF OFFSPRING, MOVE TAPE 1 COMPLETELY FORWARD IN STEPS.
C
          IF( ML ) 522, 530, 525                                              25OC7
 522 READ (1)                                                                 25OC7
          GO TO  600                                                          31AG0
 525 WRITE (2)  (( D(I,K),E(I,K), I=1,MXP3), K=1,MXP3 )                       20OC7
 530 WRITE (1) (( B (I,K), C (I,K), I=1,MXP3), K=1,MXP3 )                     29N07
 600      CONTINUE                                                            4MY7
C
C-----COMPUTE AND PRINT RESULTS
C
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          DO  650  LL = 1, MYP3                                          29NO7
              J = MYP4 - LL                                              29NO7
C-----POSITION TAPE 1 FOR READING AND RETRIEVE THE A RECURSION COEFF
      BACKSPACE 1                                                        16AG7
          DO  625  I = 1, MXP3                                           21JL7
              A(I,1) = AT(I,J)                                           28DE7
  625     CONTINUE                                                       22JE7
C-----RETRIEVE B AND C RECURSION COEFFICIENTS AT THIS J STEP
      READ (1) ((B (I,K), C (I,K),I=1,MXP3) , K=1,MXP3 )                 29NO7
C-----REPOSITION TAPE
      BACKSPACE 1                                                        16AG7
C
C-----COMPUTE DEFLECTIONS
C
C         AM1 AND AM2 ARE NOW TEMPS USED TO REPRESENT B*WP1 AND C*WP2
      CALL MATMPY (L1, MXP3, 1, B, WP1, AM1     )                        26JA8
      CALL MATMPY (L1, MXP3, 1, C, WP2, AM2     )                        26JA8
          DO  630  I = 1, MXP3                                           21JL7
              W(I,J) = A(I,1) + AM1(I,1) + AM2(I,1)                      29NO7
              WP2(I,1) = WP1(I,1)                                        28DE7
              WP1(I,1) = W(I,J)                                          28DE7
  630     CONTINUE                                                        4MY7
  650     CONTINUE                                                       04MY7
C-----SET DEFLECTIONS AT CORNER STATIONS OUTSIDE THE BOUNDARIES
              W(1,1)= 2.0 * W(1,2) - W(1,3)                              29NO7
              W(MXP3,1) = 2.0* W( MXP3,2) -W(MXP3,3)                     29NO7
              W(1,MYP3) = 2.0* W(1,MYP2) -W (1,MYP1)                     29NO7
              W(MXP3,MYP3) = 2.0 * W(MXP3,MYP2) -W(MXP3,MYP1)            29NO7
C
C-----COMPUTE BENDING MOMENTS, REACTIONS AND TWISTING MOMENTS
C
          DO  730  J  = 2, MYP2                                          24SF9
          DO  720  I = 2, MXP2                                           29NO7
              CRD(2) = AMIN1 ( DX(I   ,J  ) , DY(I   ,J  ) )             29JL8
              WSUM1 =    ODHX2 * ( W(I-1,J) - 2.0 * W(I,J) + W(I+1,J) )  06NO7
              WSUM2 =    ODHY2 * ( W(I,J-1) - 2.0 * W(I,J) + W(I,J+1) )  06NO7
              BMX(I,J)   =   DX(I,J) * WSUM1 + CRD(2)   * PR * WSUM2     29JL8
              BMY(I,J) =   DY(I,J) * WSUM2 + CRD(2)   * PR * WSUM1       29JL8
  720     CONTINUE                                                       08SE7
  730     CONTINUE                                                       08SE7
C
C----- OUTPUT TABLES
C
      PRINT 11                                                           15SE6
      PRINT  1                                                           21JL7
      PRINT 13, ( AN1(N), N = 1, 40 )                                    17OC9
      PRINT 16, NPROB, ( AN2(N), N = 1, 18 )                             17OC9
          IF ( ML ) 888, 887, 887                                        06NO9
  887 PRINT 39                                                            6NO9
      PRINT 48, SOM                                                      18AG0
          GO TO 889                                                      06NO9
  888 PRINT 42, KPROB                                                    06NO9
      PRINT 48, SOM                                                      18AG0
  889     IF (IOPPS) 9980, 892, 891                                      17AG0
  891         SDT2 = 6.0 / ( THK * THK )                                 17AG0
          GO TO 895                                                      06NO9
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 892            SDT2 = 1.0                                                 17AG0
 895 PRINT 40, SOM                                                         17AG0
        IF ( IOP8.EQ.1 )                                                   17AG0
     *PRINT 49                                                             17AG0
                ER = 1.0E-12                                               21NO7
                SUMR = 0.0                                                 12DE7
            DO  960  J = 2, MYP2                                           29NO7
            IF ( IOP8.NE.1 )    PRINT 6                                    7AG0
C-----COMPUTE ABSORBED LOADS
                JSTA = J - 2                                               29NO7
            DO  955  I = 2, MXP2                                           29NO7
                ISTA = I - 2                                               29NO7
                QBMX = ( BMX(I-1,J) - 2.0 * BMX(I,J) + BMX(I+1,J) )        02NO6CDC
C               QBMX = ( BMX(I-1,J)*1.0D0 - 2.0D0 * BMX(I,J) + BMX(I+1,J)300C9IBM
     1                    * HYDHX                                          06NO7CDC
C    1                   * 1.0D0 ) * HYDHX                                 300C9IBM
                QBMY = ( BMY(I,J-1) - 2.0 * BMY(I,J) + BMY(I,J+1) )        02NO6CDC
C               QBMY = ( BMY(I,J-1)*1.0D0 - 2.0D0 * BMY(I,J) + BMY(I,J+1)300C9IBM
     1                    * HXDHY                                          06NO7CDC
C    1                   * 1.0D0 ) * HXDHY                                 300C9IBM
                QTMX = ( W(I-1,J-1) * CH(I,J) - W(I-1,J) * ( CH(I,J)       07MY8
     1                    + CH(I,J+1) ) + W(I-1,J+1) * CH(I,J+1)           07MY8
     2                    - W(I,J-1) * ( CH(I,J) + CH(I+1,J))+ W(I,J)      07MY8
     3                    * ( CH(I,J) + CH(I,J+1) + CH(I+1,J) + CH(I+1,J 07MY8
     4                    +1) ) - W(I,J+1) * ( CH(I,J+1) + CH(I+1,J+1) ) 07MY8
     5                    + W(I+1,J-1) * CH(I+1,J) - W(I+1,J) * ( CH(I   07MY8
     6                    +1,J) + CH(I+1,J+1) ) + W(I+1,J+1) * CH(I+1,J  07MY8
     7                    +1) ) * ODHXHY                                   06NO7
                QTMY = QTMX                                                07MY8
                QPX =     ODHX      * ( PX(I,J) * W(I-1,J) - ( PX(I,J)     06NO7
     1                    + PX(I+1,J) ) * W(I,J) + PX(I+1,J) * W(I+1,J) )02NO6CDC
C    1               + 0.0D0 + PX(I+1,J) ) * W(I,J) + PX(I+1,J) * W(I+1,J))300C9IBM
                QPY =     ODHY      * ( PY(I,J) * W(I,J-1) - (PY(I,J)      06NO7
     1                    + PY(I,J+1) ) * W(I,J) + PY(I,J+1) * W(I,J+1) )02NO6CDC
C    1               + 0.0D0 + PY(I,J+1) ) * W(I,J) + PY(I,J+1) * W(I,J+1))300C9IBM
C-----COMPUTE TWISTING MOMENTS
                WSUM3  =  ( W(I-1,J-1) - W(I-1,J+1) - W(I+1,J-1) +         14DE7
     1                    W(I+1,J+1)  )  *  0.0625 * ODHXHY                06NO7
                TMX        =    ( CH(I,J) + CH(I,J+1) + CH(I+1,J) +        07MY8CDC
C               TMX        =    ( CH(I,J) + CH(I,J+1) + CH(I+1,J) + 0.0D0+300C9IBM
     1                       CH(I+1,J+1) ) * WSUM3                         07MY8
C-----SUBTRACT APPLIED LOAD FROM SUM OF ABSORBED LOADS TO GET REACT
                REACT = QBMX + QBMY + QTMX + QTMY - QPX - QPY   -Q(I,J)    06NO7
C-----SUMMATION OF REACTIONS FOR STATICS CHECK
                SUMR = SUMR + REACT                                        17JA8
            IF( REACT * REACT - ER ) 905, 905, 906                         10NO7
  905           REACT = 0.0                                                10NO7
C
C-----COMPUTE PRINCIPAL MOMENTS OR STRESSES
C
  906           BMA   =  ( BMX(I,J) + BMY(I,J) ) * 0.50                    17JA8
C     BMX IS BENDING MOMENT IN X DIRECTION (COMPRESSION IN TOP IS + )
C     TMX IS TWISTING MOMENT IN X DIRECTION (ABOUT Y AXIS)
C     SIGO IS THE MAXIMUM NUMERIC VALUE OF PRINCIPAL MOMENT ( + OR - ) .
C           IF THICKNESS SWITCH IS INPUT IT IS THE PLATE STRESS AND IS +
C           FOR TENSION IN BOTTOM OF PLATE
```

```
C     COUNTER CLOCKWISE BETA ANGLES ARE POSITIVE AND ARE MEASURED FROM
C         THE X AXIS TO THE DIRECTION OF THE LARGEST PRINCIPAL STRESS
C         OR MOMENT (POSITIVE OR NEGATIVE)
                TMY = -TMX                                                10SE9
                BMP = BMX(I,J) - BMA                                      15DE7
                BMR = SQRT ( BMP * BMP + TMY * TMY )                      10SE9CDC
C               BMR = DSQRT ( BMP * BMP + TMY * TMY )                     310C9IBM
                BMO = BMA + BMR                                           15DE7
                BMT = BMA - BMR                                           15DE7
C-----TEST TO PRINT ONLY THE MAXIMUM VALUE
          IF ( BMA ) 916, 918, 918                                        15DE7
  916           PMMAX = BMT                                               10SE9
          IF ( BMP ) 940, 930, 920                                        15DE7
  918           PMMAX = BMO                                               15DE7
          IF ( BMP ) 920, 930, 940                                        15DE7
  920           ALF = TMY / BMP                                           10SE9
                ALF = ATAN ( ALF ) * 57.29578                             10SE9CDC
C               ALF = DATAN ( ALF ) * 57.29578                            170C9IBM
          IF ( ALF ) 922, 924, 924                                        10SE9
  922           THETA =-ALF  - 180.0                                      10SE9
          GO TO 945                                                       15DE7
  924           THETA = + 180.0 - ALF                                     10SE9
          GO TO 945                                                       15DE7
  930     IF ( TMY ) 932, 934, 936                                        10SE9
  932           THETA = + 90.0                                            10SE9
          GO TO 945                                                       15DE7
  934           THETA = 0.0                                               15DE7
          GO TO 945                                                       15DE7
  936           THETA = - 90.0                                            10SE9
          GO TO 945                                                       15DE7
  940           ALF = TMY / BMP                                           10SE9
                ALF = ATAN ( ALF ) * 57.29578                             10SE9CDC
C               ALF = DATAN ( ALF ) * 57.29578                            170C9IBM
                THETA =-ALF                                               10SE9
C-----CLOCKWISE ANGLES ARE NEGATIVE
  945           BETA = 0.5 * THETA                                        15DE7
                SIGO = PMMAX * SDT2                                       15DE7
                PSIGO(I,J) = SIGO                                         26JE0
          IF ( IOP8.NE.1 )    GO TO  948                                  17AG0
          IF ( ISTA.EQ.(MX/2) .A. JSTA.EQ.(MY/2) )     GO TO  948         17AG0
          GO TO  955                                                      17AG0
  948 PRINT 47 , ISTA, JSTA, W(I,J),BMX(I,J),BMY(I,J),TMX , REACT,        08DE7
     1             SIGO,     BETA                                         14DE7
  955     CONTINUE                                                        11SE7
  960     CONTINUE                                                        09AG7
      PRINT 6                                                             17AG0
      PRINT 40, SOM                                                       17AG0
      PRINT 50, SUMR                                                      12DE7
          IF ( NCT3 ) 9980, 985, 970                                      26JE0
  970     CONTINUE                                                        26JE0
C
C----- OUTPUT TABLE 8
C
      PRINT 11                                                            24SE9
      PRINT  1                                                            24SE9
      PRINT 13, ( AN1(I), I=1, 40 )                                       170C9
```

```
      PRINT 16, NPROB, ( AN2(I), I = 1, 18 )                        170C9
         IF ( ML ) 972, 971, 971                                    26JE0
  971 PRINT 63                                                      26JE0
      PRINT 45                                                      04N09
         GO TO  973                                                 26JE0
  972 PRINT 64, KPROB                                               26JE0
      PRINT 45                                                       4N09
  973    CONTINUE                                                   26JE0
      CALL SLPLT  ( W, BMX, BMY, PSIGO, L1, L2, IPOP, 1 )           26JE0
  985    CONTINUE                                                   26JE0
      CALL TIC TOC (4)                                              25SE6
         GO TO 1010                                                 26AG3
 9980 PRINT 98                                                      29N07
 9990    CONTINUE                                                   19MR5
 9999    CONTINUE                                                   04MY3
      PRINT 11                                                       8MY3
      PRINT 1                                                       21JL7
      PRINT 13, ( AN1(N), N = 1, 40 )                               170C9
      CALL TIC TOC (2)                                              26SE6
      PRINT 19                                                      26AG3
      END
```

```
      SUBROUTINE MATRIX ( L1,JJ,MXP3,MY,AA,BB,CC,DD,EE,FF,A,AM1,           29NO7
     1                    AM2,B,BM1,BM2,C,CM1,CM2,D,E,ML   )               19AP8
C     DOUBLE PRECISION AA, BB, CC, DD, EE, FF, A, AM1, AM2, B, BM1, BM2,16OC91
C    1                 C, CM1, CM2, D, E                                   16OC91
      DIMENSION      AA (L1,1) ,          BB (L1,3) ,          CC (L1,5),  03JA8
     2               DD (L1,3) ,          EE (L1,1) ,          FF (L1,1),  19AP8
     3               A (L1,1) ,           AM1(L1,1),           AM2(L1,1),  29NO7
     4               B (L1,L1) ,          BM1(L1,L1) ,         BM2(L1,L1) ,29NO7
     5               C (L1,L1) ,          CM1(L1,L1) ,         CM2(L1,L1) ,29NO7
     6                                    D(L1,L1) ,           E(L1,L1)    26JA8
C
C-----TEST FOR MULTIPLE LOADING, IF OFFSPRING, RETRIEVE D AND E
C          RECURSION MULTIPLIERS FROM TAPE 2
C
          IF( ML ) 500, 520, 520                                           20OC7
  500 READ (2) (( D(I,K) , E(I,K) , I= 1,MXP3) , K= 1,MXP3 )               20OC7
          GO TO 550                                                        20OC7
C
C-----COMPUTE RECURSION MULTIPLIER E
  520 CALL MATMY1 (L1 , MXP3 , MXP3 , AA   , BM2 , E)                      29NO7
      CALL MATA1 (L1 , MXP3 , E , BB   , E)                                29NO7
C
C-----COMPUTE RECURSION MULTIPLIER  -1/D, C USED AS A TEMPORARY
      CALL MATMPY (L1 , MXP3 , MXP3 , E , BM1 , D) .                       29NO7
      CALL MATMY1 (L1 , MXP3 , MXP3 , AA   , CM2 , C )                     29NO7
          DO  535  K = 1, MXP3                                             21JL7
          DO  530  I = 1, MXP3                                             21JL7
               D(I,K) = - D(I,K) - C(I,K)                                  01DE7
  530     CONTINUE                                                         4MY7
  535     CONTINUE                                                         22JE7
      CALL MATS2 (L1, MXP3, D, CC, D )                                     29NO7
C
C-----COMPUTE RECURSION MULTIPLIER D
      CALL INVR5 ( D, L1, MXP3, JJ )                                       19AP8
C-----COMPUTE RECURSION COEFFICIENT C
      CALL MATM2 (L1 , MXP3 , D , EE   , C )                               29NO7
C-----COMPUTE RECURSION COEFFICIENT B, NOW USING BM2 AS A TEMPORARY
      CALL MATMPY (L1 , MXP3 , MXP3 , E , CM1 , B )                        29NO7
      CALL MATA1 (L1 , MXP3 , B   , DD   , BM2)                            21DE7
      CALL MATMPY (L1 , MXP3 , MXP3 , D , BM2 , B )                        21DE7
C-----COMPUTE RECURSION COEFFICIENT A, EE USED AS A TEMPORARY
  550 CALL MATMPY (L1 , MXP3 , 1 , E , AM1, A )                            29NO7
      CALL MATMY1 (L1 , MXP3 , 1 , AA   , AM2, EE )                        02JA8
          DO  560  I = 1, MXP3                                             21JL7
               EE(I,1) = A(I,1) + EE (I,1) - FF(I,1)                       30OC9
  560     CONTINUE                                                         04MY7
      CALL MATMPY (L1 , MXP3 , 1 , D , EE ,A   )                           02JA8
      RETURN                                                               8AG7
      END                                                                  8AG7
```

```
      SUBROUTINE MATMY1 (M1 , L2 , L , X , Y , Z)                   25JL7
C     DOUBLE PRECISION X, Y, Z                                      160C91BM
      DIMENSION  X(M1,1) , Z(M1,L) , Y(M1,L)                        03JA8
          DO 200  I = 1 , L2                                        19AP8
          DO 100  J = 1,L                                           13JL7
              Z(I,J) = X(I,1) * Y(I,J)                              03JA8
  100     CONTINUE                                                  13JL7
  200     CONTINUE                                                  19AP8
      RETURN                                                        13JL7
      END                                                           13JL7
```

```
      SUBROUTINE MATA1 (M1 , L2 , Z , X3 , Y)                       25JL7
C     DOUBLE PRECISION X3, Z, Y                                     160C91BM
      DIMENSION X3(M1,3), Z(M1,M1), Y(M1,M1)                        13JL7
              MM1 = L2 - 1                                          25JL7
          DO 60  I = 1 , L2                                         19AP8
          DO 50  J = 1 , L2                                         25JL7
              Y(I,J) = Z(I,J)                                       13JL7
   50     CONTINUE                                                  13JL7
   60     CONTINUE                                                  19AP8
          DO 100 I = 2, MM1                                         13JL7
              Y(I,I-1) = Y(I,I-1) + X3(I,1)                         13JL7
              Y(I,I) = Y(I,I) + X3(I,2)                             13JL7
              Y(I,I+1) = Y(I,I+1) + X3(I,3)                         13JL7
  100     CONTINUE                                                  13JL7
              Y(1,1) = Y(1,1) + X3(1,2)                             13JL7
              Y(1,2) = Y(1,2) + X3(1,3)                             13JL7
              Y(L2,L2-1) = Y(L2,L2-1) + X3(L2,1)                    25JL7
              Y(L2,L2) = Y(L2,L2) + X3(L2,2)                        25JL7
      RETURN                                                        13JL7
      END                                                           13JL7
```

```
      SUBROUTINE MATMPY (M1 , L2 , L , X , Y , Z)                   25JL7
C     DOUBLE PRECISION X, Y, Z                                      160C91BM
      DIMENSION X(M1,M1), Y(M1,L ), Z(M1,L )                        27JE7
          DO 300  I = 1 , L2                                        19AP8
          DO 200  M = 1,L                                           19AP8
              Z(I,M) = 0.0                                          27JE7
          DO 100  K = 1 , L2                                        25JL7
              Z(I,M) = X(I,K) * Y(K,M) + Z(I,M)                     27JE7
  100 CONTINUE                                                      27JE7
  200     CONTINUE                                                  19AP8
  300     CONTINUE                                                  19AP8
      RETURN                                                        27JE7
      END                                                           27JE7
```

```
      SUBROUTINE MATS2 (L1 , M1 , Z , X3 , Y)                          30NO7
C     DOUBLE PRECISION Z, X3, Y                                        16OC9IP
      DIMENSION X3(L1,5) , Z(L1,L1) , Y(L1,L1)                         25JL7
            MM2 = M1 - 2                                               13JL7
         DO 100 I = 3, MM2                                             13JL7
            Y(I,I-2) = Z(I,I-2) - X3(I,1)                              30NO7
            Y(I,I-1) = Z(I,I-1) - X3(I,2)                              30NO7
            Y(I,I) = Z(I,I) - X3(I,3)                                  30NO7
            Y(I,I+1) = Z(I,I+1) - X3(I,4)                              30NO7
            Y(I,I+2) = Z(I,I+2) - X3(I,5)                              30NO7
  100    CONTINUE                                                      13JL7
            Y(1,1) = Z(1,1) - X3(1,3)                                  30NO7
            Y(1,2) = Z(1,2) - X3(1,4)                                  30NO7
            Y(1,3) = Z(1,3) - X3(1,5)                                  30NO7
            Y(2,1) = Z(2,1) - X3(2,2)                                  30NO7
            Y(2,2) = Z(2,2) - X3(2,3)                                  30NO7
            Y(2,3) = Z(2,3) - X3(2,4)                                  30NO7
            Y(2,4) = Z(2,4) - X3(2,5)                                  30NO7
            Y(M1-1,M1-3) = Z(M1-1,M1-3) - X3(M1-1,1)                   30NO7
            Y(M1-1,M1-2) = Z(M1-1,M1-2) - X3(M1-1,2)                   30NO7
            Y(M1-1,M1-1) = Z(M1-1,M1-1) - X3(M1-1,3)                   30NO7
            Y(M1-1,M1) = Z(M1-1,M1) - X3(M1-1,4)                       30NO7
            Y(M1,M1-2) = Z(M1,M1-2) - X3(M1,1)                         30NO7
            Y(M1,M1-1) = Z(M1,M1-1) - X3(M1,2)                         30NO7
            Y(M1,M1) = Z(M1,M1) - X3(M1,3)                             30NO7
      RETURN                                                           13JL7
      END                                                              13JL7
```

```
      SUBROUTINE INVR5 ( A, L1, L2, JJ )                               19AP8
C     DOUBLE PRECISION A, S, S2                                        16OC9IPM
      DIMENSION  A(L1,L1)                                              25JA8
   20 FORMAT (///28H     NO INVERSE EXISTS    JJ=, I5 , 10H  A(I,J) =  ) 30OC9
   30 FORMAT ( 1X,10E10.3 )                                            10OC7
   31 FORMAT (// 50H NOTE.  THIS IS USUALLY DUE TO AN ILL-DEFINED OR   31AG0
     1         / 52H        INSTABLE STRUCTURE - CHECK YOUR INPUT FOR  31AG0
     2         / 52H        ERRORS.  (BEWARE WHEN MODELING CRACKS THAT 31AG0
     3         / 52H        THE STIFFNESS AT THE CRACK IS GREATER THAN 31AG0
     4         / 52H        ZERO) - ALSO THIS WILL HAPPEN IF THE SLAB  31AG0
     5         / 51H        HAS BUCKLED DUE TO EXCESSIVE AXIAL THRUST  )31AG0
            EP = 1.0E-10                                               21DE7
         DO 185  I = 1 , L2                                            20OC7
            KK = I + 1                                                 20OC7
         IF ( ABS(A(I,I) ) - EP ) 990, 990, 150                        19AP8COC
C        IF ( DABS(A(I,I) ) - EP ) 990, 990, 150                       30OC9IPM
  150       S = 1 / A(I,I)                                             20OC7
         DO 160  J = 1, L2                                             25JA8
            A(I,J) = A(I,J) * S                                        20OC7
  160    CONTINUE                                                      20OC7
            A(I,I) = S                                                 25JA8
         DO 180  J = 1 , L2                                            20OC7
         IF ( J-I ) 170, 180, 170                                      20OC7
  170       S2 = A(J,I)                                                20OC7
```

```
          A(J,I) = 0.0
        DO 175  K = 1, L2                                            25JAR
          A(J,K) = A(J,K) - S2 * A(I,K)                              25JAR
  175   CONTINUE                                                     20OC7
  180   CONTINUE                                                     20OC7
  185   CONTINUE                                                     20OC7
      RETURN                                                         20OC7
  990 PRINT 20, JJ                                                   20OC7
      PRINT 30, (( A(I,J), J=1,L2) , I=1, L2 )                       10JAR
      PRINT 31                                                      .25JAR
      END                                                            31AGO
                                                                     20OC7
```

```
      SUBROUTINE MATM2 (M1 , L2 , Y , X , Z)
C     DOUBLE PRECISION X, Y, Z                                       25JL7
      DIMENSION  X(M1,1) , Z(M1,M1) , Y(M1, M1)                      16OC9I
        DO 200  I = 1 , L2                                           03JA8
        DO 100  J = 1 , L2                                           19AP8
          Z(I,J) = X(J,1) * Y(I,J)                                   25JL7
  100   CONTINUE                                                     03JA8
  200   CONTINUE                                                     13JL7
      RETURN                                                         19APR
      END                                                            13JL7
                                                                     13JL7
```

```
      SUBROUTINE TIC TOC (J)                                            240C6
C
C-----THIS ROUTINE IS SPECIFICALLY FOR THE CDC6600. WHEN USING THE
C     IBM360/50 SYSTEM THE INDICATED IBM CARDS WILL CALL THE SUBROUTINE
C     PRTIME TO PRINTOUT THE REQUIRED TIME.
C
C-----  TIC TOC (1)  =  COMPILE TIME                                    20DE7
C       TIC TOC (2)  =  ELAPSED  TM TIME                                300C9
C       TIC TOC (3)  =  TIME FOR THIS PROBLEM                           20DE7
C       TIC TOC (4)  =  TIME FOR THIS PROBLEM  AND  ELAPSED  TM TIME    300C9
   10 FORMAT(///30X19HELAPSED      TIME = I5,8H MINUTESF9.3,8H SECONDS ) 31AGC
   11 FORMAT(///30X15HCOMPILE TIME = ,I5,8H MINUTES,F9.3,8H SECONDS    ) 25SE6
   12 FORMAT(///30X24HTIME FOR THIS PROBLEM = ,I5,8H MINUTES,F9.3,      25SE6
     1        8H SECONDS   )                                            25SE6
              I = J - 2                                                 21JY7
          IF ( I-1 ) 40, 30, 30                                         21JY7
   30         F14 = F                                                   25SE6
   40 CALL SECOND (F)                                                   25SE6CDC
C  40 CALL PRTIME                                                       300C9IBM
C         GO TO 990                                                     300C9IBM
              I11 = F                                                   25SE6
              I1 = I11 / 60                                             25SE6
              F12 =  F - I1*60                                          25SE6
          IF ( I ) 50, 70, 60                                           24JL7
   50 PRINT 11, I1, F12                                                 21JY7
          GO TO 990                                                     25SE6
   60         F13 = F - F14                                             25SE6
              I2 = F13 / 60                                             25SE6
              F13 = F13 - I2*60                                         25SE6
      PRINT 12, I2, F13                                                 25SE6
          IF ( I-1 ) 990, 990, 70                                       21JY7
   70 PRINT 10, I1, F12                                                 21JY7
  990     CONTINUE                                                      06SE7
      RETURN                                                            25SE6
      END                                                               25SE6
```

```
      SUBROUTINE PLOP ( Q, L1, L2, NCT6, NCT7, MX, MY )                 26JE0
C - - - - THIS SUBROUTINE ACCEPTS SPECIAL LOAD PATTERNS AND THEIR        18AG0
C         PLACEMENTS, AND GENERATES THE APPROPRIATE LOAD VALUES FOR     18AG0
C         SOLUTION BY THE MAIN PROGRAM.                                 18AG0
      DIMENSION IN16( 9,12), JN16( 9,12), QP( 9,12), NQ(9), Q(L1,L2),   26JE0
     1            IN17( 7),    JN17( 7)                                 26JE0
      DATA  QP / 108 * 0.0 /                                            07SE0
   60 FORMAT ( I2,2X I2, 2X 24I3 )                                      26JE0
   61 FORMAT ( 8X 12F6.0 )                                              26JE0
   64 FORMAT ( 5X50H PATTERN    NUM OF          PATTERN COORDINATES AND 17AG0
     1            30H CONCENTRATED LOADS                                26JE0
     2 /, 5X      50H  NUM      LOADS      X    Y    X    Y    X    Y   X 17AG0
     3            30H   Y    X    Y    X    Y                            18AG0
     4  / 26X     10HREFERENCE )                                        17AG0
   65 FORMAT ( /5XI5, 5X I4, 4X 6( I5, I4 ) )                           17AG0
   66 FORMAT (  23X 6( 3X F6.0 ) )                                      03JL0
   67 FORMAT ( 26X 6( I3,1X,I3 ) )                                      26JE0
   70 FORMAT ( //50H     TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS /)17AG0
   71 FORMAT ( 16I5 )                                                   26JL0
   72 FORMAT ( 2I10, 1X 7( I5,I4 ) )                                    26JE0
   74 FORMAT (    50H       PATTERN   NUM OF          LOCATION OF REFE  17AG0
     1            30HRENCE LOAD (SLAB COORDINATES)   /                  17AG0
     2            50H          NUM   PLACEMENTS X    Y    X    Y    X    Y  17AG0
     3            35H  X    Y    X    Y    X    Y    X    Y  / )         26JE0
   80 FORMAT (///50H     NUM OF WHEEL LOADS APPLIED TO THE SLAB   =     17AG0
     1 I10,/      50H     SUM OF WHEEL LOADS APPLIED TO THE SLAB   =    26JE0
     2 E10.3, /   50H    -NUM OF WHEEL LOADS PLACED OUTSIDE SLAB   =    17AG0
     3 I10,/      50H     SUM OF WHEEL LOADS PLACED OUTSIDE SLAB   =    26JE0
     4 E10.3 )                                                          26JE0
      PRINT 64                                                          26JE0
          IF ( NCT6.EQ.0 )      GO TO  115                              07SE0
               NCT6D2 = NCT6 / 2                                        26JE0
          DO 110  N = 1, NCT6D2                                         07SE0
      READ 60, NP, NL, (  IN16(NP,J), JN16(NP,J), J = 1, NL )           26JE0
               NQ(NP) = NL                                              26JE0
      READ 61, ( QP(NP,I), I = 1, NL )                                  26JE0
          IF ( NL .GE. 12 )          GO TO  110                         07SE0
               NLP1 = NL + 1                                            07SE0
          DO 100  I = NLP1, 12                                          07SE0
  100          QP(NP,I) = 0.0                                           07SE0
  110     CONTINUE                                                      07SE0
  115     DO 150  NP = 1, 9                                             07SE0
          DO 120  I = 1, 12                                             07SE0
          IF ( QP(NP,I) .EQ. 0. )  GO TO  120                           07SE0
               NL = NQ(NP)                                              07SE0
          GO TO  122                                                    07SE0
  120     CONTINUE                                                      07SE0
          GO TO  150                                                    07SE0
  122     IF ( NL.GT.6 )      GO TO  140                                07SE0
      PRINT 65, NP, NL, ( IN16(NP,J), JN16(NP,J), J = 1, NL )           26JE0
      PRINT 66, ( QP(NP,I), I = 1, NL )                                 26JE0
          GO TO  150                                                    26JE0
  140 PRINT 65, NP, NL, ( IN16(NP,J), JN16(NP,J), J = 1, 6  )           26JE0
      PRINT 66, ( QP(NP,I), I = 1, 6  )                                 26JE0
      PRINT 67, ( IN16(NP,J), JN16(NP,J), J = 7, NL )                   26JE0
      PRINT 66, ( QP(NP,I), I = 7, NL )                                 26JE0
```

```
150      CONTINUE                                                        26JEO
155           QPSUM = 0.0                                                31AGO
              QPOSUM = 0.0                                               26JEO
              LQP = 0                                                    26JEO
              LQPO = 0                                                   26JEO
      PRINT 70                                                           26JEO
      PRINT 74                                                           26JEO
         DO 300  N = 1, NCT7                                             26JEO
      READ 71, NP, NSP, ( IN17(I),JN17(I), I = 1, NSP )                  26JEO
      PRINT 72,NP, NSP, ( IN17(I),JN17(I), I = 1, NSP )                  26JEO
              NL = NQ(NP)                                                26JEO
         DO 290  IP = 1, NSP                                             29JEO
         DO 280  IL = 1, NL                                              29JEO
              I = IN16(NP,IL) + IN17(IP)                                 18AGO
              J = JN16(NP,IL) + JN17(IP)                                 18AGO
         IF ( I.LT.0 .O. I.GT.MX .O. J.LT.0 .O. J.GT.MY )  GO TO  260    29JEO
              I = I + 2                                                  18AGO
              J = J + 2                                                  18AGO
              QPSUM = QPSUM + QP(NP,IL)                                  29JEO
              LQP = LQP + 1                                              26JEO
              Q(I,J) = Q(I,J) + QP(NP,IL)                                29JEO
         GO TO 280                                                       26JEO
260           QPOSUM = QPOSUM + QP(NP,IL)                                29JEO
              LQPO = LQPO + 1                                            26JEO
280      CONTINUE                                                        26JEO
290      CONTINUE                                                        26JEO
300      CONTINUE                                                        26JEO
      PRINT 80, LQP, QPSUM, LQPO, QPOSUM                                 26JEO
      RETURN                                                             26JEO
      END                                                                26JEO
```

```
      SUBROUTINE CUPS ( CH, DX, DY, S, L1, L2 )                         26JE0
      COMMON / CUPS /            EM, SKK, IOPD, IOPC, IOPS, MX, MY      17AG0
C - - - - THIS SUBROUTINE GENERATES THE OPTIONAL PAVEMENT STIFFNESS     18AG0
C         CONSTANTS.  APPROPRIATE QUARTER AND HALF VALUES ARE           18AG0
C         GENERATED AT THE EDGES.                                       18AG0
      COMMON / SPLT / MX, MY, THK, NCT3, NDE, PR                        26JE0
      DIMENSION  DX(L1,L2), DY(L1,L2), CH(L1,L2), S(L1,L2)              26JE0
   40 FORMAT ( / 50H     TABLE 4. ( CONTD ) COMPUTED OPTIONAL PAVEMENT  18AG0
     1            15H STIFFNESSES                                       18AG0
     2 //         37H        FROM   THRU      DX        DY              18AG0
     3      10X  25H              S           C                         07SE0
     4 //  7X    5H1    1 I3,I4,2X2H0.9X2H0.20X2H0.8XF10.3,             18AG0
     5  /  7X    5H0    0 I3,I4, 2E11.3, 11X E11.3, 4H  0.
     6  /  7X    5H1    0 I3,I4, 2E11.3, 11X E11.3, 4H  0.              18AG0
     7  /  7X    5H0    1 I3,I4, 2E11.3, 11X E11.3, 4H  0.              18AG0
     8  /  7X    5H1    1 I3,I4, 2E11.3, 11X E11.3, 4H  0. )            18AG0
            DXG04 = 0.0                                                 26JE0
            SG04 = 0.0                                                  26JE0
            CHGEN = 0.0                                                 26JE0
            MYP1 = MY + 1                                               26JE0
            MYP2 = MY + 2                                               26JE0
            MXP2 = MX + 2                                               26JE0
            MXP1 = MX + 1                                               26JE0
            MXM1 = MX - 1                                               26JE0
            MYM1 = MY - 1                                               26JE0
        IF ( IOPD.NE.1 )    GO TO  110                                  03JL0
            DXGEN = ( EM * THK**3 ) / ( 12. * ( 1. - PR*PR ) )          26JE0
            DXG04 = DXGEN * .25                                         26JE0
  100   IF ( IOPC.NE.1 )    GO TO  110                                  26JE0
            CHGEN = DXGEN * ( 1. - PR )                                 26JE0
  110   IF ( IOPS.NE.1 )    GO TO  200                                  26JE0
            SG04 = SKK * MX * MY * .25                                  26JE0
  200 PRINT 40, MX, MY, CHGEN, MX,MY, DXG04, DXG04, SG04                26JE0
     1         , MXM1,    MY, DXG04, DXG04, SG04                        26JE0
     2         ,   MX,  MYM1, DXG04, DXG04, SG04                        26JE0
     3         , MXM1,  MYM1, DXG04, DXG04, SG04                        26JE0
        IF ( IOPC.NE.1 )    GO TO  300                                  26JE0
        DO 250  I = 3, MXP2                                             26JE0
        DO 250  J = 3, MYP2                                             26JE0
  250       CH(I,J) = CH(I,J) + CHGEN                                   26JE0
  300   CONTINUE                                                        26JE0
        DO 310  I = 2, MXP2                                             26JE0
        DO 310  J = 2, MYP2                                             26JE0
            DX(I,J) = DX(I,J) + DXG04                                   26JE0
            DY(I,J) = DY(I,J) + DXG04                                   26JE0
  310       S(I,J) = S(I,J) + SG04                                      26JE0
        DO 320  I = 3, MXP1                                             26JE0
        DO 320  J = 2, MYP2                                             26JE0
            DX(I,J) = DX(I,J) + DXG04                                   26JE0
            DY(I,J) = DY(I,J) + DXG04                                   26JE0
  320       S(I,J) = S(I,J) + SG04                                      26JE0
        DO 340  I = 2, MXP2                                             26JE0
        DO 340  J = 3, MYP1                                             26JE0
            DX(I,J) = DX(I,J) + DXG04                                   26JE0
            DY(I,J) = DY(I,J) + DXG04                                   26JE0
  340       S(I,J) = S(I,J) + SG04                                      26JE0
```

```
      DO 350  I = 3, MXP1                                                 26JE0
      DO 350  J = 3, MYP1                                                 26JE0
          DX(I,J) = DX(I,J) + DXG04                                       26JE0
          DY(I,J) = DY(I,J) + DXG04                                       26JE0
  350     S(I,J) = S(I,J) + SG04                                          26JE0
      RETURN                                                              26JE0
      END                                                                 26JE0
```

```
      SUBROUTINE ZOT1  ( XX, YY, NEND, ID )                               28JE0
C - - - THIS ROUTINE ( WHEN ACTIVATED ) DRIVES A CALCOMP  763
C       IF YOU HAVE A  763  AND DESIRE THE USE OF THIS ROUTINE
C       CONTACT  FRANK L ENDRES  , AUSTIN RESEARCH ENGINEERS INC.
C                                3128 MANOR RD.  AUSTIN, TEX   78723
      RETURN
      END
```

```
      SUBROUTINE SPLTD2  ( KEY, NEND, X, DUM )                            02JE0
      DIMENSION X(NEND), DUM(1)                                           02JE0
      COMMON /PLOT/ I1, I2, J1, J2                                        25N09
          IF ( KEY.EQ.1 )             CALL SPLOT3 ( X, NEND, DUM )        18N09
          IF ( KEY.EQ.2 )             CALL SPLOT4 ( X, DUM, NEND )        18N09
      RETURN                                                              15OC9
      END                                                                 15OC9
```

```
      SUBROUTINE SLPLT  ( W, BMX, BMY, SIGO, L1, L2, IPOP, IC )          02JE0
      COMMON / ZUT / LOP, MC, IPOLL, MOP                                  15JE0CDC
      COMMON / SPLT / MX, MY, THK, NCT3, NDE, PR, SOM                     31AG0
      COMMON /PLOT/ I1, I2, J1, J2                                        29MY0
      DIMENSION  IN13( 10 ), IN23( 10 ), JN13( 10 ), JN23( 10 ),          19MY0
     1           KASEW(10) , KASEX(10) , KASFY(10) , KASEP(10) ,          12MY0
     2           TEMX (300), TEMY (300), XX(300),                         15JE0
     3           W(L1,L2)  , BMX(L1,L2), BMY(L1,L2), SIGO(L1,L2)          18MY0
      DATA ID1, ID2, ID3, ID4 /10HDEFLECTION, 10HBEND MOM X,              15JE0CDC
     1                         10HBEND MOM Y, 10H   SIGO    /             15JE0CDC
   46 FORMAT (5X, 2(1X,I2,1X,I3),22X,E11.3)                               23OC7CDC
   56 FORMAT ( 4( 2X, I3 ), 4( 4X, I1 ) )                                 20AP0
   57 FORMAT ( 5X, 2( 1X, I2, 1X, I3 ), 6X, I2, 11X, I2, 2(11X,I2) )      20AP0
   65 FORMAT (///,15X,26HX MOMENTS ONLY, BETWEEN  (          ,I3,1H,,I3,  05NO9
     1           8H ) AND ( ,I3, 1H,,I3,2H )    ,  ///,                   26NO9
     2           30H      X , Y  X MOMENT          , /          )         25NO9
   66 FORMAT ( 15X, I2, 1X, I3, 10X, E10.3 )                              23SE9CDC
C  66 FORMAT ( 15X, I2, 1X, I3, 10X, 1PE10.3 )                            17OC9IBM
   67 FORMAT (///,15X,26HY MOMENTS ONLY, BETWEEN  (          ,I3,1H,,I3,  05NO9
     1           8H ) AND ( ,I3, 1H,,I3,2H )    ,  ///,                   26NO9
     2           30H      X , Y  Y MOMENT          ,/           )         25NO9
   68 FORMAT ( 15X, I2, 1X, I3, 10X, E10.3 )                              23SE9CDC
C  68 FORMAT ( 15X, I2, 1X, I3, 10X, 1PE10.3 )                            17OC9IBM
   69 FORMAT (///,15X,32HBOTH X AND Y MOMENTS, BETWEEN  (          ,I3,   05NO9
     1           1H,,I3, 8H ) AND ( ,I3, 1H,,I3, 2H )     ,///,           26NO9
     2           22H      X , Y  X MOMENT   , 28X, 10H Y MOMENT  ,/ )     26NO9
   74 FORMAT ( 15X, I2, 1X, I3, 10X, E10.3, 3X, E10.3 )                   30OC9CDC
C  74 FORMAT ( 15X, I2, 1X, I3, 10X, 1PE10.3, 3X, 1PE10.3 )               30OC9IBM
   86 FORMAT (///,15X,26HDEFLECTIONS, BETWEEN     (          ,I3,1H,,I3,  20AP0
     1           8H ) AND ( ,I3, 1H,,I3,2H )    ,  ///,                   20AP0
     2           30H      X , Y  DEFLECTION     ,/          )             20AP0
   87 FORMAT (///,15X,10HPRINCIPAL A6,16HES, BETWEEN  . (          ,I3,   31AG0
     1           1H,,I3, 8H ) AND ( ,I3, 1H,,I3, 2H )     ,///,           27AP0
     2           13H      X , Y     A6              ,/          )         31AG0
   90 FORMAT (// 45H        **** CAUTION.  TOTAL NUMBER OF SPECIFIED      05MR0
     1           10H POINTS IS  , I5, /,                                  05MR0
     2           40H      SHOULD NOT BE GREATER THAN 300      ,//)        05MR0
         IF ( IC.NE.0 )        GO TO  800                                 12MY0
         DO 100  I = 1, 300                                               15JE0CDC
              XX(I) = I - 1                                               15JE0CDC
  100    CONTINUE                                                         15JE0CDC
              LOP = -1                                                    15JE0CDC
              MC = 10                                                     15JE0CDC
              IROLL = 1                                                   15JE0CDC
              MOP = 0                                                     15JE0CDC
C                                                                         12MY0
C------ INPUT TABLE 3
C                                                                         12MY0
         DO  175  N = 1, NCT3                                             18MY0
      READ  56, IN13(N), JN13(N), IN23(N), JN23(N), KASEW(N), KASEX(N),   20AP0
     1           KASEY(N), KASEP(N)                                       20AP0
      PRINT 57, IN13(N), JN13(N), IN23(N), JN23(N), KASEW(N), KASEX(N),   20AP0
     1           KASEY(N), KASEP(N)                                       20AP0
              NEND =  (IN23(N)-IN13(N)+1)*(JN23(N)-JN13(N)+1)             05MR0
         IF ( IN13(N) - IN23(N) ) 154, 154, 153                           02OC9
  153         NDE = NDE + 1                                               24SE9
```

```
 154      IF ( JN13(N) - JN23(N) ) 156, 156, 155                        24SF9
 155            NDE = NDE + 1                                           24SE9
 156      IF ( IN23(N) - MX ) 158, 158, 157                             24SF9
 157            NDE = NDE + 1                                           24SE9
 158      IF ( JN23(N) - MY ) 160, 160, 159                             24SE9
 159            NDE = NDE + 1                                           24SE9
 160      IF ( KASEX(N) - 1 ) 162, 162, 161                             09OC9
 161            NDE = NDE + 1                                           09OC9
 162      IF ( KASEY(N) - 1 ) 164, 164, 163                             09OC9
 163            NDE = NDE + 1                                           09OC9
 164      IF ( KASEW(N) - 1 ) 166, 166, 165                             20APO
 165            NDE = NDE + 1                                           20APO
 166      IF ( KASEP(N) - 1 ) 168, 168, 167                             20APO
 167            NDE = NDE + 1                                           20APO
 168      IF ( NEND - 300 ) 174, 174, 173                               20APO
 173            NDE = NDE + 1                                           20APO
      PRINT 90, NEND                                                    05MRO
 174      CONTINUE                                                      20APO
 175      CONTINUE                                                      20APO
          GO TO  9000                                                   12MYO
C
C----- OUTPUT TABLES
C
 800      CONTINUE                                                      15JEO
          IF ( IPOP.EQ.3 )    MOP = 1                                   15JEOCDC
                IPOP = IPOP - 1                                         20MYO
          DO 818  N = 1, KCT3                                           20MYO
          IF ( KASEW(N) - 1 ) 818, 802, 9980                            20MYO
 802  PRINT 86, IN13(N), JN13(N), IN23(N), JN23(N)                      20MYO
                I1 = IN13(N) + 2                                        20APO
                I2 = IN23(N) + 2                                        20APO
                J1 = JN13(N) + 2                                        20APO
                J2 = JN23(N) + 2                                        20APO
                NEND = (I2-I1+1)*(J2-J1+1)                              20APO
                K = 0                                                   20APO
          IF ( (J2-J1)-(I2-I1) ) 804, 804, 808                          20MYO
 804      DO  806  J = J1, J2                                           20MYO
          DO  806  I = I1, I2                                           20MYO
                K = K + 1                                               20APO
                TEMX(K) = W(I,J)                                        20APO
 806      CONTINUE                                                      20MYO
          GO TO 812                                                     20MYO
 808      DO  810  I = I1, I2                                           20MYO
          DO  810  J = J1, J2                                           20MYO
                K = K + 1                                               20APO
                TEMX(K) = W(I,J)                                        20APO
 810      CONTINUE                                                      20MYO
 812      IF ( IPOP ) 814, 816, 816                                     20MYO
 814  CALL SPLTD2  ( 1, NEND, TEMX, 20. )                               25MYO
          GO TO 818                                                     20MYO
 816      CONTINUE                                                      15JFO
                ID = ID1                                                15JEOCDC
      CALL ZOT 1  ( XX, TEMX, NEND, ID )                                15JEOCDC
                NP2 = NEND + 2                                          19JEO
          DO 817  I = 1, NP2                                            19JFO
 817            XX(I) = I - 1                                           19JFO
```

```
      IF ( IPOP.EQ.1 )    GO TO  814                              20MYO
818   CONTINUE                                                    20MYO
820   CONTINUE                                                    20MYO
      DO  880  N = 1, NCT3                                        05NO9
      IF ( KASEX(N) * KASEY(N) - 1 ) 824, 822, 9980               20MYO
822 PRINT 69, IN13(N), JN13(N), IN23(N), JN23(N)                  20MYO
      GO TO 832                                                   20MYO
824   IF ( KASEX(N) - 1 ) 828, 826, 9980                          20MYO
826 PRINT 65, IN13(N), JN13(N), IN23(N), JN23(N)                  20MYO
      GO TO 832                                                   20MYO
828   IF ( KASEY(N) - 1 ) 880, 830, 9980                          20MYO
830 PRINT 67, IN13(N), JN13(N), IN23(N), JN23(N)                  20MYO
832   CONTINUE                                                    20MYO
          I1 = IN13(N) + 2                                        24SE9
          J1 = JN13(N) + 2                                        24SE9
          I2 = IN23(N) + 2                                        24SE9
          J2 = JN23(N) + 2                                        24SE9
          NEND = (I2-I1+1)*(J2-J1+1)                              11NO9
          K = 0                                                   25NO9
      DO  836  J = J1, J2                                         20MYO
      DO  834  I = I1, I2                                         20MYO
          K = K + 1                                               25NO9
          TEMX(K) = BMX(I,J)                                      25NO9
          TEMY(K) = BMY(I,J)                                      25NO9
834   CONTINUE                                                    20MYO
836   CONTINUE                                                    20MYO
      IF ( IPOP ) 838, 865, 865                                   21MYO
838   IF ( KASEX(N) * KASEY(N) - 1 ) 842, 840, 9980               20MYO
840 CALL SPLTD2  ( 2, NEND, TEMX, TEMY )                          25MYO
      GO TO 880                                                   25MYO
842   IF ( KASEX(N) - 1 ) 844, 843, 9980                          20MYO
843 CALL SPLTD2  ( 1, NEND, TEMX, 20. )                           25MYO
      GO TO 880                                                   25MYO
844   IF ( KASEY(N) - 1 ) 9980, 846, 9980                         20MYO
846   IF ( (J2-J1)-(I2-I1) ) 854, 854, 848                        20MYO
848       K = 0                                                   20MYO
      DO  852  I = I1, I2                                         20MYO
      DO  850  J = J1, J2                                         20MYO
          K = K + 1                                               12DE9
          TEMY(K) = BMY(I,J)                                      12DE9
850   CONTINUE                                                    20MYO
852   CONTINUE                                                    20MYO
854 CALL SPLTD2  ( 1, NEND, TEMY, 20.   )                         25MYO
856   CONTINUE                                                    20MYO
865   CONTINUE                                                    15JEO
      IF ( KASEX(N).EQ.1 )      ID = ID2                          15JEOCDC
      IF ( KASEX(N).EQ.1 )      CALL ZOT 1  ( XX, TEMX, NEND, ID ) 15JEOCDC
          NP2 = NEND + 2                                          19JEO
      DO 870  I = 1, NP2                                          19JEO
870       XX(I) = I - 1                                           19JEO
      IF ( KASEY(N).EQ.1 )      ID = ID3                          15JEOCDC
      IF ( KASEY(N).EQ.1 )      CALL ZOT 1  ( XX, TEMY, NEND, ID ) 15JEOCDC
      DO 872  I = 1, NP2                                          19JEO
872       XX(I) = I - 1                                           19JEO
      IF ( IPOP.EQ.1 )    GO TO  838                              20MYO
880   CONTINUE                                                    5NO9
```

```
      DO  984  N = 1, NCT3                                              20MYO
      IF ( KASEP(N) - 1 ) 984, 881, 9980                                20MYO
881 PRINT 87, SOM, IN13(N), JN13(N), IN23(N), JN23(N), SOM              07SEO
            I1 = IN13(N) + 2                                            12MYO
            I2 = IN23(N) + 2                                            12MYO
            J1 = JN13(N) + 2                                            12MYO
            J2 = JN23(N) + 2                                            12MYO
            NEND = (I2-I1+1)*(J2-J1+1)                                  12MYO
            K = 0                                                       12MYO
      IF ( (J2-J1) - (I2-I1) ) 885,885,887                              02JEO
885   DO 886  J = J1, J2                                                02JEO
      DO 886  I = I1, I2                                                02JEO
            K = K + 1                                                   02JEO
            TEMX(K) = SIGO(I,J)                                         02JEO
886   CONTINUE                                                          02JEO
      GO TO 890                                                         02JEO
887   DO 888  I = I1, I2                                                02JEO
      DO 888  J = J1, J2                                                02JEO
            K = K + 1                                                   02JEO
            TEMX(K) = SIGO(I,J)                                         02JEO
888   CONTINUE                                                          02JEO
890   CONTINUE                                                          02JEO
      IF ( IPOP ) 965, 970, 970                                         20MYO
965 CALL SPLTD2  ( 1, NEND, TEMX, 20. )                                 25MYO
      GO TO  984                                                        20MYO
970   CONTINUE                                                          15JEO
            ID = ID4                                                    15JEOCDC
    CALL ZOT 1  ( XX, TEMX, NEND, ID )                                  15JEOCDC
            NP2 = NEND + 2                                              19JEO
      DO 972  I = 1, NP2                                                19JEO
972         XX(I) = I - 1                                               19JEO
      IF ( IPOP.EQ.1 )    GO TO  965                                    20MYO
984   CONTINUE                                                          20MYO
985   CONTINUE                                                          20MYO
9000 RETURN                                                             20MYO
9980  CONTINUE                                                          19MYO
    END
```

```
      SUBROUTINE SPLOT 3 ( X, NEND, WIDTH )                            18NO9
C * * * * THE LATEST REVISION DATE FOR THIS ROUTINE IS. -  -  12 DEC 69 REVISED
      DIMENSION X(NEND), SPACE(15), SYMB(4)                            10DC9
      COMMON /PLOT/ I1, I2, J1, J2                                     25NO9
      DATA SPACE / 15*4H    /, SYMB / 4H*   ,4H *  ,4H  * ,4H   * /    10DC9
C******** THIS ROUTINE PRINTS AND PLOTS THE NEND VALUES OF X            10DC9
C        BEGINNING WITH THE INITIAL VALUE TRANSFERRED.                 10DC9
C        THE PAPER SHOULD BE POSITIONED PROPERLY AND ALL               10DC9
C        HEADINGS PRINTED BEFORE CALLING. F. L. E.                     10DC9
C  ****  INPUT -   X, THE FUNCTION TO BE PLOTTED                       10DC9
C                NEND, THE NUMBER OF X TO BE PLOTTED                   14DC9
C                WIDTH, WIDTH OF PLOT( LESS THAN 61 )                  14DC9
C  ****  OUTPUT-   NO ACTUAL VALUES ARE RETURNED TO THE                10DC9
C                  CALLING ROUTINE - THE VALUES ARE PRINTED            10DC9
C                  AND PLOTTED VERTICALLY.                             10DC9
   10 FORMAT ( 5X, I2, 1X, I3, 1X, E10.3,16A4 )                        25NO9
   15 FORMAT ( 5X,I2,1X,I3,1X,E10.3 )                                  25NO9
         IF ( NEND .LE. 0 )               GO TO 990                    11NO9
         IF ( WIDTH.GT.60. .OR. WIDTH.LT.1. )    WIDTH = 60.           15DC9
            ISKP = WIDTH / 8 + 1                                       14DC9
            SYMD = SYMB(1)                                             10DC9
            OMEGA = X(1)                                               10DC9
            THETA = X(1)                                               10DC9
         IF ( NEND .EQ. 1 )               GO TO 120                    25NO9
         DO 50  I = 2, NEND                                            10DC9
         IF ( OMEGA.LT.X(I) )             OMEGA = X(I)                 10DC9
         IF ( THETA.GT.X(I) )             THETA = X(I)                 10DC9
   50    CONTINUE                                                      10DC9
         IF ( OMEGA.EQ.THETA )            GO TO  60                    25NO9
            SIGMA = ( WIDTH - 1. ) / ( OMEGA - THETA )                 10DC9
   60    CONTINUE                                                      25NO9
         IF ( (J2-J1-I2+I1) .GT. 0 )      GO TO 150                    12DE9
            I = 0                                                      25NO9
         DO 110 JS = J1, J2                                            25NO9
            JSTA = JS - 2                                              25NO9
         DO 100 IS = I1, I2                                            25NO9
            ISTA = IS - 2                                              25NO9
            I = I + 1                                                  25NO9
         IF ( OMEGA.EQ.THETA )            GO TO  80                    10DC9
            BETA = SIGMA * ( X(I) - THETA ) + 1.                       10DC9
            IOTA = BETA                                                10DC9
         IF ( (BETA - IOTA).GE.0.5 )     IOTA = IOTA + 1               10DC9
            ISKP = ( IOTA - 1 ) / 4                                    10DC9
            IR   = IOTA - 4 * ISKP                                     10DC9
            ISKP = ISKP + 1                                            10DC9
            SYMD = SYMB(IR)                                            10DC9
   80 PRINT 1., ISTA, JSTA, X(I), ( SPACE(L), L=1, ISKP ), SYMD         25NO9
  100    CONTINUE                                                      25NO9
  110    CONTINUE                                                      25NO9
         GO TO 990                                                     25NO9
  150    CONTINUE                                                      12DE9
            I = 0                                                      12DE9
         DO  210  IS = I1, I2                                          12DE9
            ISTA = IS - 2                                              12DE9
            DO  200  JS = J1, J2                                       12DE9
            JSTA = JS - 2                                              12DE9
```

```
            I = I + 1                                                 25NO9
        IF ( OMEGA.EQ.THETA ).          GO TO  180                    12DE9
            BETA = SIGMA * ( X(I) - THETA ) + 1.                      10OC9
            IOTA = BETA                                               10OC9
        IF ( (BETA - IOTA).GE.0.5 )   IOTA = IOTA + 1                 10OC9
            ISKP = ( IOTA - 1 ) / 4                                   10OC9
            IR   = IOTA - 4 * ISKP                                    10OC9
            ISKP = ISKP + 1                                           10OC9
            SYMD = SYMB(IR)                                           10OC9
  180 PRINT 16, ISTA, JSTA, X(I), ( SPACE(L), L=1, ISKP ), SYMD       12DE9
  200     CONTINUE                                                    12DE9
  210     CONTINUE                                                    12DE9
          GO TO 990                                                   12DE9
  120 PRINT 15, I1, J1, X(1)                                          25N39
  990 RETURN                                                          11NO9
C     END SPLOT 3                                                     10MY0
      END                                                             10OC9
```

```
      SUBROUTINE SPLOT 4 ( X, Y, NEND )                                 18NO9
C * * * * THE LATEST REVISION DATE FOR THIS ROUTINE IS  -  -  25 NOV 69 REVISED
      DIMENSION X(NEND), Y(NEND), SPACE( 8), SYMB(4)                    15OC9
      COMMON /PLOT/ I1, I2, J1, J2                                      25NO9
      DATA SPACE /  8*4H    /, SYMB / 4H*   ,4H *  ,4H  * ,4H   * /     15OC9
C******** THIS ROUTINE PRINTS AND PLOTS THE NEND VALUES OF X AND Y      10OC9
C         BEGINNING WITH THE INITIAL VALUE TRANSFERRED.                 10OC9
C         THE PAPER SHOULD BE POSITIONED PROPERLY AND ALL               10OC9
C         HEADINGS PRINTED BEFORE CALLING. F. L. E.                     10OC9
C  ****   INPUT -   X, THE FUNCTION TO BE PLOTTED                       10OC9
C                   Y, THE FUNCTION TO BE PLOTTED                       14OC9
C               NEND, THE NUMBER OF X  OR Y TO BE PLOTTED               14OC9
C  ****   OUTPUT-   NO ACTUAL VALUES ARE RETURNED TO THE                10OC9
C                   CALLING ROUTINE - THE VALUES ARE PRINTED            10OC9
C                   AND PLOTTED VERTICALLY.                             10OC9
   10 FORMAT ( 5X, I2,1X,I3,1X,E10.3,7A4,E10.3,7A4 )                    25NO9
   15 FORMAT ( 5X,I2,1X,I3,1X,E10.3,28X,E10.3 )                         25NO9
      IF ( NEND .LE. 0 )                  GO TO 990                     11NO9
         IW = 20                                                        18NO9
         IX = IW / 4                                                    14OC9
         ISKP  = IW / 8                                                 14OC9
         ISKP2 = ISKP                                                   11NO9
         ISKPT = 4                                                      14NO9
         ISKPF = ISKP                                                   14OC9
         SYMD  = SYMB(1)                                                14OC9
         SYMD2 = SYMB(1)                                                14OC9
         WIDTH = IW                                                     14OC9
         OMEGA = X(1)                                                   10OC9
         THETA = X(1)                                                   10OC9
         O2 = Y(1)                                                      14OC9
         T2 = Y(1)                                                      14OC9
      IF ( NEND .EQ. 1 )                  GO TO 120                     25NO9
      DO 50  I = 2, NEND                                                10OC9
      IF ( OMEGA.LT.X(I) )                OMEGA = X(I)                  10OC9
      IF ( THETA.GT.X(I) )                THETA = X(I)                  10OC9
      IF (    O2.LT.Y(I) )                O2 = Y(I)                     14OC9
      IF (    T2.GT.Y(I) )                T2 = Y(I)                     14OC9
   50 CONTINUE                                                          10OC9
      IF ( OMEGA.EQ.THETA )               GO TO  60                     25NO9
         SIGMA = ( WIDTH - 1. ) / ( OMEGA - THETA )                     10OC9
   60 IF ( O2.EQ.T2 )                     GO TO  70                     14OC9
         S2 = ( WIDTH - 1 ) / ( O2 - T2 )                               14OC9
   70 CONTINUE                                                          25NO9
         I = 0                                                          25NO9
      DO 110 JS = J1, J2                                                25NO9
         JSTA = JS - 2                                                  25NO9
      DO 100 IS = I1, I2                                                25NO9
         ISTA = IS - 2                                                  25NO9
         I = I + 1                                                      25NO9
      IF ( OMEGA.EQ.THETA )               GO TO  80                     10OC9
         BETA = SIGMA * ( X(I) - THETA ) + 1.                           10OC9
         IOTA = BETA                                                    10OC9
      IF ( (BETA - IOTA).GE.0.5 )   IOTA = IOTA + 1                     10OC9
         ISKP = ( IOTA - 1 ) / 4                                        10OC9
         IR   = IOTA - 4 * ISKP                                         10OC9
         ISKP = ISKP + 1                                                10OC9
```

```
           SYMD = SYMB(IR)                                         100C9
 80     IF (    D2.EQ.T2    )             GO TO  90                140C9
           BETA = S2 * ( Y(I) - T2 ) + 1.                          150C9
           IOTA = BETA                                             140C9
        IF ( (BETA - IOTA).GE.0.5 )    IOTA = IOTA + 1             140C9
           ISKP2 = ( IOTA - 1 ) / 4                                140C9
           IR    = IOTA - 4 * ISKP2                                140C9
           SYMD2 = SYMB(IR)                                        140C9
           ISKP2 = ISKP2 + 1                                       140C9
           ISKPT = IX - ISKP + 1                                   150C9
 90 PRINT 16, ISTA, JSTA, X(I), (SPACE(K),K=1,ISKP), SYMD          25NO9
   1       , (SPACE(L),L=1,ISKPT), Y(I), (SPACE(K),K=1,ISKP2), SYMD2 25NO9
100     CONTINUE                                                   25NO9
110     CONTINUE                                                   25NO9
        GO TO 990                                                  25NO9
120 PRINT 15, I1, J1, X(1), Y(1)                                   25NO9
990 RETURN                                                         11NO9
C     END SPLOT 4                                                  18MY0
      END                                                          10OC9
```

COMPUTER RESULTS OF EXAMPLE PROBLEMS

DATA LISTING

```
    SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE         - 24 SEPT 70 - JJP,FLE,JLR
    CONTRACT DACA 23-70-C-0076                           UNITS ARE LBS AND INCHES
601K     BRIDGE APPROACH SLAB (FROM REF 3, SIMILAR PROB IN REF 1)
    0              1    3   13    2    4    2         1    1    0         0    0
   12   16 2.400E+01 2.400E+01 2.500E-01 4.000E+06 1.000E+01         0
    0   15   12   15    1    1    0    1
    4    0    4   16    1    0    1    1
    0   12   12   16    1    0    0    0
    0    0   12   16                    -1.500E+02
    0    1   12   15                    -1.500E+02
    1    0   11   16                    -1.500E+02
    1    1   11   15                    -1.500E+02
    0    7   12    7          -1.777E+08
    1    7   11    7          -1.777E+08
    6    0    6   16-1.777E+08
    6    1    6   15-1.777E+08
    0    0   12    1                               1.000E+30
    0    7   12   15                               1.440E+04
    1    7   11   15                               1.440E+04
    0    7   12   16                               1.440E+04
    1    7   11   16                               1.440E+04
    0    1   12   16                                                  -6.000E+04
    1    1   11   16                                                  -6.000E+04
1   4    0  0  3  0  0  3  3  3
       -10000-10000-10000-10000
2   2    0  0 -3  0
        -5000 -5000
    1    2    1   15    1   -4
    2    1    4   -8
JR5      4-25FT SQ TAXIWAY SLABS, 2 C-5A BOGIES CENTERED ON 25 PERCENT JOINTS
    1              1    4    4    0    2    1         1    1    1         1    1
   20   28 3.000E+01 2.150E+01 2.000E-01 5.000E+06 1.200E+01 1.250E+02
    3    8   17   21    1    0    0    1
    0   20   20   21    1    1    0    0
    0   21   20   21    1    1    0    0
    9    0    9   28    1    0    1    0
   10    0   10   28-2.812E+08
   10    1   10   27-2.812E+08
    0   14   20   14          -2.812E+08
    1   14   19   14          -2.812E+08
1   7     0  0 -2  1 -1  1  1  1  2  1 -1 -2  1 -2
            0-30000-30000-30000-30000-30000-30000
    1    2   10   10   10   20
JR6      4-25FT SQ TAXIWAY SLABS, 2 B-747 BOGIES, 25 PERCENT JOINTS
   -1              0    4    0    0    2    1         0    0    0         1    1
    3    8   17   21    1    0    0    1
    0   21   20   21    1    1    0    0
    9    0    9   28    1    0    1    0
   12    0   12   28    1    0    1    0
1   6    0  0  0  3  1  0  2  0  1  3  2  3
        -41500-41500-41500-41500-41500-41500
    1    2    7   12   12   18
SAC1     8 X 8  REG
                   1    0    6    0    0    0              0
    8    8 6.        6.        .25      0.         .9788     0.
    0    0    8    8 6.25E+05  6.25E+05           1.000E+20
    1    0    7    8 0.625E+06 0.625E+06
    0    1    8    7 0.625E+06 0.625E+06
    1    1    7    7 0.625E+06 0.625E+06          -1.000E+20
    4    4    4    4                    -1.000F+05
    1    1    8    8                                         1.875F+06
```

```
PROGRAM [illegible] SPECIAL DECK-ARE-JJP,FLE   REVISION DATE 07 SEP 70
     SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE        - 24 SEPT 70 - JJP,FLE,JLR
     CONTRACT [illegible] 23-70-C-0070                      UNITS ARE LBS AND INCHES

PROB
 601A      BRIDGE APPROACH SLAB (FROM REF 3, SIMILAR PROB IN REF 1)
```

TABLE 1 CONTROL DATA.

```
     MULTIPLE LOAD OPTION (IF BLANK OR ZERO, PROB IS INDEPENDENT --          0
          IF +1, PARENT FOR NEXT PROB -- IF -1, AN OFFSPRING PROB)

                                                      TABLE NUMBER
                                                2    3    4    5    6    7
     NUM CARDS INPUT THIS PROBLEM               1    3   13    2    4    2

     COMPUTE OPTIONAL PAVEMENT STIFFNESS CONSTANTS  (1=YES)   DX,DY  C    S
                                                               1     1    0
     OPTION TO SUPPRESS DETAILED OUTPUT (1=YES)                           0
     OPTION TO PRINT PRIN STRESS INSTEAD OF MOM (1=YES)                   0
```

TABLE 2. CONSTANTS—UNITS MUST BE CONSISTENT.

```
     NUM INCREMENTS IN X DIRECTION                                   12
     NUM INCREMENTS IN Y DIRECTION                                   16
     INCR LENGTH IN X DIRECTION                               2.400E+01
     INCR LENGTH IN Y DIRECTION                               2.400E+01
     POISSONS RATIO                                           2.500E-01
     MODULUS OF ELASTICITY                                    4.000E+06
     SLAB THICKNESS                                           1.000E+01
     SUBGRADE MODULUS                                         0.
```

TABLE 3. SPECIFIED AREAS FOR SELECTED PLOTTED OUTPUT.

```
                              PLOT  (1=YES)
   FROM     THRU          DEFL        X-MOMENT       Y-MOMENT    PRIN MOMENT
   0  15  12  15           1              1              0             1
   4   0   4  16           1              0              1             1
   0  12  12  16           1              0              0             0
```

TABLE 4. STIFFNESS AND LOAD DATA.

```
   FROM     THRU          DX              DY          Q              S              C

   0   0  12  16 -0.             -0.          -1.500E+02 -0.                  -0.
   0   1  12  15 -0.             -0.          -1.500E+02 -0.                  -0.
   1   0  11  15 -0.             -0.          -1.500E+02 -0.                  -0.
   1   1  11  15 -0.             -0.          -1.500E+02 -0.                  -0.
   0   7  12   7 -0.             -1.777E+08   -0.           -0.               -0.
   1   7  11   7 -0.             -1.777E+08   -0.           -0.               -0.
   0   0   0  16 -1.777E+08      -0.          -0.           -0.               -0.
   0   1   0  15 -1.777E+08      -0.          -0.           -0.               -0.
   0   0  12   1 -0.             -0.          -0.            1.000E+30        -0.
```

0	7	12	15	-0.	-0.	-0.	1.440E+04	-0.
1	7	11	15	-0.	-0.	-0.	1.440E+04	-0.
0	7	12	16	-0.	-0.	-0.	1.440E+04	-0.
1	7	11	16	-0.	-0.	-0.	1.440E+04	-0.

TABLE 4. (CONTD) COMPUTED OPTIONAL PAVEMENT STIFFNESSES

FROM		THRU		DX	DY	S	C
1	1	12	16	0.	0.	0.	2.667E+08
0	[illegible]	12	15	[illegible]E+07	6.509E+07	0.	0.
1	[illegible]	11	16	[illegible]E+07	[illegible]E+07	0.	0.
0	1	12	15	[illegible]E+07	[illegible]E+07	0.	0.
1	1	11	15	[illegible]E+07	[illegible]E+07	0.	0.

TABLE 5. AXIAL THRUST DATA.

FROM		THRU		PX	PY
0	1	12	16	-0.	-6.000E+04
1	1	11	16	-0.	-6.000E+04

TABLE 6. SPECIAL LOAD PATTERNS.

PATTERN NUM	NUM OF LOADS	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
		REFERENCE											
1	4	0	0	3	0	0	3	3	3				
		-10000		-10000		-10000		-10000					
2	2	0	0	-3	0								
		-5000		-5000									

PATTERN COORDINATES AND CONCENTRATED LOADS

TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS.

LOCATION OF REFERENCE LOAD (SLAB COORDINATES)

PATTERN NUM	NUM OF PLACEMENTS	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1	2	1	15	1	-4										
2	1	4	-3												

NUM OF WHEEL LOADS APPLIED TO THE SLAB = 2
SUM OF WHEEL LOADS APPLIED TO THE SLAB = -2.000E+04
NUM OF WHEEL LOADS PLACED OUTSIDE SLAB = 8
SUM OF WHEEL LOADS PLACED OUTSIDE SLAB = -7.000E+04

PROGRAM SLAB30E CERL SPECIAL DECK-ARC-JJP-FLE REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE - 24 SEPT 70 - JJP,FLE,JLR
CONTRACT DACA 23-70-C-0076 . UNITS ARE LBS AND INCHES

PROB (CONTD)
601M BRIDGE APPROACH SLAB (FROM REF 3, SIMILAR PROB IN REF 1)

TABLE 6. RESULTS.
X MOMENT AND X TWISTING MOMENT ACT IN THE X DIRECTION (ABOUT Y AXIS), Y TWISTING MOMENT = -X TWISTING MOMENT, COUNTERCLOCKWISE BETA ANGLES ARE POSITIVE FROM X AXIS TO THE DIRECTION OF LARGEST PRINCIPAL MOMENT

X	Y	DEFL	X MOMENT	Y MOMENT	X TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL MOMENT	BETA X TO LARGEST
0	0	1.241E-27	2.657E-36	-9.300E-36	-6.955E+01	-1.241E+03	-6.955E+01	45.0
1	0	2.622E-27	-4.125E-22	-3.912E-35	-5.527E-22	-2.622E+03	-7.962E-22	34.8
2	0	2.577E-27	8.615E-24	-4.339E-35	1.339E-22	-2.577E+03	1.383E-22	44.1
3	0	2.562E-27	5.206E-24	-5.044E-35	3.693E-25	-2.562E+03	8.285E-24	2.6
4	0	2.576E-27	7.434E-24	-4.252E-35	-1.110E-22	-2.576E+03	.150E-22	-44.0
5	0	2.617E-27	-1.204E-24	-3.100E-35	1.396E-22	-2.617E+03	-1.392E-22	-44.9
6	0	2.653E-27	-7.927E-27	-5.259E-35	-3.691E-24	-2.653E+03	-3.695E-24	45.0
7	0	2.631E-27	-1.348E-24	-5.669E-35	-1.459E-22	-2.631E+03	-1.465E-22	44.9
8	0	2.604E-27	7.714E-24	-4.872E-35	1.039E-22	-2.604E+03	1.078E-22	43.9
9	0	2.604E-27	3.176E-24	-4.252E-35	-7.434E-24	-2.604E+03	1.257E-23	-30.6
10	0	2.632E-27	8.523E-24	-3.720E-35	-1.443E-22	-2.632E+03	1.487E-22	-44.2
11	0	2.609E-27	-4.251E-22	-4.615E-35	5.576E-22	-2.609E+03	-8.093E-22	-34.6
12	0	1.277E-27	-3.432E-36	-1.082E-35	7.137E+01	-1.277E+03	-7.137E+01	-45.0
0	1	-1.945E-27	-9.095E-12	-1.291E+03	-1.442E+01	1.949E+03	-1.391E+03	89.4
1	1	-6.277E-27	-7.305E+02	-2.922E+03	1.668E+01	6.277E+03	-2.922E+03	-89.6
2	1	-5.392E-27	-7.193E+02	-2.877E+03	1.117E+01	5.392E+03	-2.877E+03	-89.7
3	1	-5.361E-27	-7.156E+02	-2.862E+03	2.262E-01	5.361E+03	-2.862E+03	-90.0
4	1	-5.390E-27	-7.190E+02	-2.876E+03	-1.021E+01	5.390E+03	-2.876E+03	89.7
5	1	-6.262E-27	-7.292E+02	-2.917E+03	-1.447E+01	6.262E+03	-2.917E+03	89.6
6	1	-4.112E-27	-3.230E-01	-2.953E+03	-2.639E+00	4.112E+03	-2.953E+03	89.9
7	1	-6.279E-27	-7.327E+02	-2.931E+03	9.241E+00	6.279E+03	-2.931E+03	-89.8
8	1	-5.425E-27	-7.260E+02	-2.904E+03	5.116E+00	5.425E+03	-2.904E+03	-89.9
9	1	-5.413E-27	-7.259E+02	-2.904E+03	-5.182E+00	5.413E+03	-2.904E+03	89.9
10	1	-5.462E-27	-7.329E+02	-2.932E+03	-1.600E+01	5.462E+03	-2.932E+03	89.6
11	1	-6.388E-27	-7.473E+02	-2.989E+03	-2.124E+01	6.388E+03	-2.989E+03	89.5
12	1	-1.995E-27	-1.819E-12	-1.427E+03	1.372E+01	1.995E+03	-1.427E+03	-89.4
0	2	-4.607E-03	-6.457E-11	-4.585E+02	1.171E+02	0.	-4.867E+02	-76.5
1	2	-4.793E-03	-2.217E+02	-8.641E+02	5.222E+01	0.	-8.882E+02	-85.5
2	2	-4.591E-03	-2.497E+02	-8.872E+02	2.240E+01	0.	-8.880E+02	-88.0
3	2	-4.631E-03	-2.493E+02	-8.902E+02	-5.463E-01	0.	-8.902E+02	90.0
4	2	-4.654E-03	-2.483E+02	-8.918E+02	-2.264E+01	0.	-8.926E+02	88.0
5	2	-4.725E-03	-2.194E+02	-8.941E+02	-4.499E+01	0.	-8.978E+02	85.8
6	2	-4.784E-03	-3.391E-02	-8.974E+02	-7.310E+00	0.	-8.974E+02	89.6
7	2	-4.744E-03	-2.219E+02	-9.049E+02	3.556E+01	0.	-9.067E+02	-87.0
8	2	[illegible]	-2.532E+02	-9.130E+02	4.769E+00	0.	-9.131E+02	-89.2
9	2	[illegible]	-2.507E+02	-9.209E+02	-1.271E+01	0.	-9.212E+02	88.9
10	2	[illegible]	-2.572E+02	-9.252E+02	-3.505E+01	0.	-9.280E+02	87.0
11	2	[illegible]	-2.119E+02	-9.297E+02	-6.390E+01	0.	-9.354E+02	84.8

12	2	-4.493E-03	3.001E-11	-4.840E+02	-1.236E+02	0.	-5.137E+02	76.5
0	3	-1.120E-02	-5.457E-11	2.582E+02	1.041E+02	0.	2.949E+02	70.0
1	3	[illegible]	3.482E+01	5.026E+02	5.293E+01	0.	5.110E+02	82.4
2	3	-1.075E-02	6.033E+01	4.929E+02	1.794E+01	0.	4.936E+02	87.6
3	3	-1.074E-02	6.530E+01	4.805E+02	-3.448E+00	0.	4.865E+02	-89.5
4	3	-1.075E-02	5.298E+01	4.839E+02	-2.422E+01	0.	4.853E+02	-86.7
5	3	-1.083E-02	4.277E+01	4.836E+02	-6.771E+01	0.	4.937E+02	-81.5
6	3	-1.114E-02	1.926E-01	5.173E+02	-1.089E+01	0.	5.176E+02	-88.8
7	3	-1.048E-02	4.173E+01	4.758E+02	4.632E+01	0.	4.805E+02	84.0
8	3	-1.036E-02	5.829E+01	4.684E+02	3.877E+00	0.	4.684E+02	89.5
9	3	-1.049E-02	6.550E+01	4.644E+02	-1.540E+01	0.	4.650E+02	-87.8
10	3	-1.049E-02	5.528E+01	4.655E+02	-3.521E+01	0.	4.685E+02	-85.1
11	3	-1.115E-02	3.512E+01	4.711E+02	-7.905E+01	0.	4.850E+02	-80.0
12	3	-1.154E-02	1.114E-10	2.410E+02	-1.127E+02	0.	2.854E+02	-60.5
0	4	-1.679E-02	6.003E-11	6.711E+02	4.969E+01	0.	6.747E+02	85.8
1	4	-1.621E-02	1.605E+02	1.290E+03	2.958E+01	0.	1.290E+03	88.5
2	4	-1.601E-02	2.201E+02	1.271E+03	3.513E+00	0.	1.271E+03	89.8
3	4	-1.598E-02	2.455E+02	1.262E+03	-7.623E+00	0.	1.262E+03	-89.6
4	4	-1.604E-02	2.290E+02	1.260E+03	-1.928E+01	0.	1.260E+03	-89.0
5	4	-1.626E-02	1.841E+02	1.268E+03	-4.339E+01	0.	1.270E+03	-87.8
6	4	-1.675E-02	3.841E-01	1.395E+03	-1.362E+01	0.	1.395E+03	-89.4
7	4	-1.633E-02	1.844E+02	1.262E+03	1.675E+01	0.	1.262E+03	89.1
8	4	-1.627E-02	2.300E+02	1.249E+03	-6.678E+00	0.	1.249E+03	-89.6
9	4	-1.630E-02	2.400E+02	1.247E+03	-1.493E+01	0.	1.247E+03	-89.1
10	4	-1.644E-02	2.259E+02	1.252E+03	-2.360E+01	0.	1.252E+03	-88.7
11	4	-1.674E-02	1.593E+02	1.269E+03	-4.410E+01	0.	1.271E+03	-87.5
12	4	-1.731E-02	-1.019E-10	6.594E+02	-5.929E+01	0.	6.652E+02	-84.9
0	5	-1.984E-02	2.401E-10	7.651E+02	-2.236E+01	0.	7.663E+02	-88.3
1	5	-1.937E-02	1.804E+02	1.470E+03	-2.587E+01	0.	1.470E+03	-88.8
2	5	-1.917E-02	2.640E+02	1.448E+03	-1.726E+01	0.	1.448E+03	-89.2
3	5	-1.914E-02	2.871E+02	1.440E+03	-1.208E+01	0.	1.440E+03	-89.4
4	5	-1.924E-02	2.654E+02	1.438E+03	-6.271E+00	0.	1.438E+03	-89.7
5	5	-1.953E-02	1.915E+02	1.450E+03	3.490E+00	0.	1.450E+03	89.8
6	5	-2.005E-02	4.239E-01	1.601E+03	-1.575E+01	0.	1.601E+03	-89.4
7	5	-1.968E-02	1.945E+02	1.447E+03	-3.414E+01	0.	1.447E+03	-88.4
8	5	-1.960E-02	2.736E+02	1.431E+03	-2.203E+01	0.	1.431E+03	-88.9
9	5	-1.958E-02	2.920E+02	1.429E+03	-1.281E+01	0.	1.430E+03	-89.4
10	5	-1.974E-02	2.585E+02	1.436E+03	-4.124E+00	0.	1.436E+03	-89.8
11	5	-2.017E-02	1.685E+02	1.457E+03	6.760E+00	0.	1.457E+03	89.7
12	5	-2.070E-02	2.155E-12	7.594E+02	1.269E+01	0.	7.596E+02	89.0
0	6	-2.041E-02	1.905E-10	5.402E+02	-9.032E+01	0.	5.549E+02	-80.8
1	6	-2.008E-02	1.267E+02	1.039E+03	-7.575E+01	0.	1.045E+03	-85.3
2	6	-1.995E-02	1.769E+02	1.025E+03	-3.570E+01	0.	1.027E+03	-87.6
3	6	-1.995E-02	1.905E+02	1.020E+03	-1.595E+01	0.	1.020E+03	-88.9
4	6	-2.014E-02	1.861E+02	1.018E+03	4.914E+00	0.	1.018E+03	89.7
5	6	-2.031E-02	1.150E+02	1.026E+03	4.706E+01	0.	1.029E+03	87.0
6	6	-2.075E-02	2.957E-01	1.131E+03	-1.740E+01	0.	1.131E+03	-89.1
7	6	-2.057E-02	1.408E+02	1.024E+03	-8.082E+01	0.	1.031E+03	-84.1
8	6	-2.057E-02	1.955E+02	1.014E+03	-3.563E+01	0.	1.016E+03	-87.5
9	6	-2.063E-02	2.069E+02	1.014E+03	-1.025E+01	0.	1.014E+03	-89.3
10	6	-2.090E-02	1.596E+02	1.019E+03	1.429E+01	0.	1.019E+03	89.0
11	6	-2.115E-02	1.325E+02	1.033E+03	5.761E+01	0.	1.037E+03	86.4
12	6	-2.150E-02	-2.005E-10	5.374E+02	8.144E+01	0.	5.500E+02	81.6
0	7	-1.994E-02	-3.473E-10	3.288E-01	-1.020E+02	5.495E+02	1.022E+02	-45.0
1	7	-1.972E-02	-4.169E+01	6.702E-01	-8.137E+01	1.095E+03	-1.046E+02	37.7

2	7	[illegible]	-4.200E+01	8.407E-01	-2.554E+01	1.096E+03	-5.394E+01	25.1
3	7	[illegible]	-1.450E+01	7.114E-01	6.807E+00	1.100E+03	-3.583E+01	-10.6
4	7	-1.92[illegible]E-02	-2.871E+01	7.452E-01	3.930E+01	1.108E+03	-5.595E+01	-34.7
5	7	-1.94[illegible]E-02	[illegible]	7.824E-01	9.132E+01	1.118E+03	-1.067E+02	-41.0
6	7	[illegible]	2.737E-01	8.225E-01	3.051E+00	1.131E+03	3.594E+00	47.8
7	7	-1.975E-02	-1.530E+01	8.334E-01	-8.773E+01	1.137E+03	-9.561E+01	42.3
8	7	[illegible]	-1.071E+01	8.421E-01	-3.497E+01	1.145E+03	-4.022E+01	40.3
9	7	-2.003E-02	-1.720E+01	8.481E-01	-3.667E+00	1.154E+03	-1.316E+01	14.7
10	7	-2.021E-02	-2.156E+01	8.533E-01	2.880E+01	1.164E+03	-3.944E+01	-33.4
11	7	[illegible]	-3.057E+01	8.569E-01	7.713E+01	1.176E+03	-9.363E+01	-39.2
12	7	[illegible]	5.75[illegible]E-11	4.263E-01	9.445E+01	5.955E+02	9.467E+01	45.1
0	8	-1.531E-02	-3.256E-10	-3.130E+02	-6.475E+01	4.409E+02	-3.259E+02	78.8
1	8	-1.543E-02	-7.512E+01	-5.943E+02	-5.040E+01	8.914E+02	-5.993E+02	84.3
2	8	-1.555E-02	-1.236E+02	-5.754E+02	1.067E+00	8.955E+02	-5.754E+02	-89.9
3	8	-1.559E-02	-1.280E+02	-5.574E+02	3.802E+01	8.982E+02	-5.608E+02	-85.0
4	8	-1.562E-02	-1.094E+02	-5.367E+02	7.498E+01	8.998E+02	-5.495E+02	-80.3
5	8	-1.551E-02	-7.356E+01	-5.153E+02	1.224E+02	8.949E+02	-5.470E+02	-75.5
6	8	-1.554E-02	-1.802E-01	-5.408E+02	3.068E+01	8.925E+02	-5.426E+02	-86.8
7	8	[illegible]	-8.091E+01	-4.799E+02	-6.399E+01	9.119E+02	-4.894E+02	81.5
8	8	-1.607E-02	-5.457E+01	-4.701E+02	-2.422E+01	9.255E+02	-4.716E+02	86.4
9	8	-1.625E-02	-9.514E+01	-4.658E+02	3.347E+00	9.359E+02	-4.658E+02	-89.5
10	8	-1.637E-02	-7.503E+01	-4.644E+02	2.975E+01	9.439E+02	-4.668E+02	-85.4
11	8	-1.644E-02	-7.508E+01	-4.684E+02	6.574E+01	9.501E+02	-4.791E+02	-80.7
12	8	-1.653E-02	4.320E-11	-2.494E+02	5.890E+01	4.761E+02	-2.588E+02	-77.2
0	9	-1.252E-02	1.792E-10	-4.766E+02	-2.469E+01	3.636E+02	-4.783E+02	86.6
1	9	-1.292E-02	-1.095E+02	-9.091E+02	-9.353E+00	7.440E+02	-9.092E+02	89.3
2	9	-1.301E-02	-1.557E+02	-8.700E+02	2.851E+01	7.492E+02	-8.712E+02	-87.7
3	9	-1.295E-02	-1.553E+02	-8.286E+02	6.083E+01	7.483E+02	-8.340E+02	-84.9
4	9	-1.249E-02	-1.220E+02	-7.812E+02	9.616E+01	7.423E+02	-7.950E+02	-81.9
5	9	-1.265E-02	-7.017E+01	-7.298E+02	1.351E+02	7.298E+02	-7.564E+02	-78.9
6	9	-1.223E-02	-3.251E-01	-7.353E+02	5.441E+01	7.045E+02	-7.393E+02	-85.8
7	9	-1.272E-02	-5.125E+01	-6.392E+02	-3.236E+01	7.328E+02	-6.410E+02	86.8
8	9	-1.303E-02	-4.545E+01	-6.105E+02	-8.352E+00	7.505E+02	-6.107E+02	89.1
9	9	-1.322E-02	-3.457E+01	-5.941E+02	1.044E+01	7.615E+02	-5.943E+02	-89.8
10	9	-1.333E-02	-9.572E+01	-5.860E+02	2.796E+01	7.677E+02	-5.876E+02	-86.7
11	9	-1.335E-02	-5.737E+01	-5.875E+02	4.570E+01	7.608E+02	-5.917E+02	-84.9
12	9	-1.323E-02	-4.594E-11	-3.033E+02	2.934E+01	3.810E+02	-3.062E+02	-84.5
0	10	-1.159E-02	1.725E-11	-5.774E+02	6.170E+00	3.336E+02	-5.775E+02	-89.4
1	10	-1.144E-02	-1.140E+02	-1.102E+03	4.605E+01	6.845E+02	-1.104E+03	-87.3
2	10	-1.152E-02	-1.537E+02	-1.041E+03	7.451E+01	6.856E+02	-1.047E+03	-85.2
3	10	-1.172E-02	-1.523E+02	-9.732E+02	1.031E+02	6.771E+02	-9.860E+02	-82.9
4	10	-1.105E-02	-1.024E+02	-8.946E+02	1.406E+02	6.596E+02	-9.188E+02	-80.2
5	10	-1.074E-02	-4.651E+01	-8.022E+02	1.745E+02	6.294E+02	-8.422E+02	-77.4
6	10	-1.015E-02	-4.357E-01	-7.613E+02	1.037E+02	5.850E+02	-7.752E+02	-82.4
7	10	[illegible]	-3.223E+01	-6.383E+02	1.617E+01	6.159E+02	-6.387E+02	-88.5
8	10	[illegible]	-4.179E+01	-5.866E+02	2.207E+01	6.341E+02	-5.875E+02	-87.6
9	10	-1.11[illegible]E-02	-7.405E+01	-5.535E+02	2.657E+01	6.439E+02	-5.550E+02	-86.8
10	10	-1.124E-02	-5.797E+01	-5.345E+02	3.110E+01	6.474E+02	-5.366E+02	-86.2
11	10	-1.119E-02	-4.186E+01	-5.261E+02	3.419E+01	6.443E+02	-5.304E+02	-85.0
12	10	-1.094E-02	1.726E-11	-2.679E+02	1.231E+01	3.161E+02	-2.685E+02	-87.4
0	11	-1.284E-02	0.	-6.581E+02	4.357E+01	3.612E+02	-6.590E+02	-86.2
1	11	-1.27[illegible]E-02	-1.152E+02	-1.251E+03	1.145E+02	7.317E+02	-1.262E+03	-84.3
2	11	[illegible]	-1.473E+02	-1.166E+03	1.348E+02	7.215E+02	-1.185E+03	-82.2
3	11	-1.213E-02	[illegible]	-1.073E+03	1.640E+02	6.989E+02	-1.101E+03	-80.3
4	11	-1.158E-02	-5.017E+01	-9.652E+02	2.127E+02	6.633E+02	-1.014E+03	-77.4
5	11	[illegible]	-1.222E+01	-8.260E+02	2.632E+02	6.098E+02	-9.038E+02	-73.5

6	11	-9.015E-03	-5.377E-01	-7.285E+02	1.858E+02	5.368E+02	-7.731E+02	-76.5
7	11	-9.759E-03	-2.101E+01	-5.791E+02	8.277E+01	5.618E+02	-5.911E+02	-81.7
8	11	-9.476E-03	-4.657E-01	-5.040E+02	6.790E+01	5.746E+02	-5.139E+02	-81.7
9	11	-1.003E-02	-5.424E+01	-4.537E+02	5.340E+01	5.795E+02	-4.607E+02	-82.5
10	11	-1.004E-02	-4.245E+01	-4.225E+02	4.223E+01	5.780E+02	-4.272E+02	-83.7
11	11	-9.910E-03	-1.899E+01	-4.005E+02	3.233E+01	5.713E+02	-4.091E+02	-85.3
12	11	-9.653E-03	-3.001E-11	-2.014E+02	7.033E+00	2.779E+02	-2.017E+02	-88.0
0	12	-1.575E-02	4.204E-10	-6.960E+02	8.602E+01	4.540E+02	-7.065E+02	-83.1
1	12	-1.564E-02	-7.401E+01	-1.335E+03	1.941E+02	9.008E+02	-1.364E+03	-81.3
2	12	-1.579E-02	-1.653E+02	-1.223E+03	2.200E+02	8.694E+02	-1.267E+03	-78.7
3	12	-1.431E-02	-1.951E+02	-1.114E+03	2.331E+02	8.242E+02	-1.166E+03	-77.6
4	12	-1.322E-02	3.130E+01	-1.002E+03	3.082E+02	7.617E+02	-1.097E+03	-74.6
5	12	-1.165E-02	4.077E+01	-8.167E+02	3.931E+02	6.711E+02	-9.696E+02	-68.7
6	12	-9.858E-03	-5.525E-01	-6.709E+02	3.016E+02	5.562E+02	-7.866E+02	-69.0
7	12	-9.905E-03	-3.334E+01	-5.041E+02	1.660E+02	5.640E+02	-5.572E+02	-72.3
8	12	-9.793E-03	-5.845E+01	-4.137E+02	1.263E+02	5.641E+02	-4.541E+02	-72.3
9	12	-9.704E-03	-5.717E+01	-3.517E+02	8.885E+01	5.590E+02	-3.764E+02	-74.4
10	12	-9.562E-03	-3.523E+01	-3.112E+02	6.032E+01	5.508E+02	-3.238E+02	-78.2
11	12	-9.346E-03	-8.111E+00	-2.874E+02	3.934E+01	5.343E+02	-2.928E+02	-82.1
12	12	-9.029E-03	1.371E-10	-1.382E+02	9.591E+00	2.598E+02	-1.388E+02	-86.0
0	13	-2.134E-02	5.093E-11	-6.109E+02	1.240E+02	6.161E+02	-6.351E+02	-79.0
1	13	-2.083E-02	2.743E+01	-1.208E+03	2.732E+02	1.200E+03	-1.266E+03	-78.1
2	13	-1.973E-02	-1.475E+02	-1.074E+03	3.148E+02	1.135E+03	-1.170E+03	-72.9
3	13	-1.836E-02	-4.332E+01	-9.744E+02	2.803E+02	1.058E+03	-1.052E+03	-74.5
4	13	-1.658E-02	2.613E+02	-9.071E+02	4.058E+02	9.606E+02	-1.034E+03	-72.6
5	13	-1.415E-02	1.358E+02	-7.026E+02	5.594E+02	8.150E+02	-9.025E+02	-63.4
6	13	-1.106E-02	-7.893E-01	-5.566E+02	4.371E+02	6.394E+02	-7.967E+02	-61.2
7	13	-1.071E-02	-7.715E+01	-4.093E+02	2.571E+02	6.171E+02	-5.493E+02	-61.4
8	13	-1.030E-02	-1.009E+02	-3.264E+02	1.874E+02	5.933E+02	-4.336E+02	-60.2
9	13	-9.973E-03	-9.075E+01	-2.657E+02	1.262E+02	5.720E+02	-3.318E+02	-62.4
10	13	-9.502E-03	-5.174E+01	-2.220E+02	8.078E+01	5.531E+02	-2.550E+02	-68.3
11	13	-9.267E-03	-1.205E+01	-1.956E+02	5.001E+01	5.338E+02	-2.085E+02	-75.7
12	13	-8.869E-03	8.572E-11	-9.130E+01	1.503E+01	2.554E+02	-9.371E+01	-80.9
0	14	-2.913E-02	1.028E-10	-2.430E+02	1.234E+02	8.391E+02	-2.947E+02	-67.3
1	14	-2.813E-02	4.535E+02	-5.421E+02	3.154E+02	1.620E+03	-6.334E+02	-73.8
2	14	-2.610E-02	-1.257E+02	-4.918E+02	4.070E+02	1.503E+03	-7.552E+02	-57.1
3	14	-2.408E-02	3.573E+01	-4.375E+02	2.624E+02	1.387E+03	-5.542E+02	-66.0
4	14	-2.181E-02	8.373E+02	-4.044E+02	4.621E+02	1.256E+03	9.905E+02	18.3
5	14	-1.792E-02	2.759E+02	-3.230E+02	7.112E+02	1.032E+03	-7.951E+02	-56.4
6	14	-1.341E-02	-9.523E-01	-3.263E+02	5.375E+02	7.724E+02	-7.252E+02	-53.4
7	14	-1.230E-02	-1.524E+02	-2.749E+02	3.251E+02	7.042E+02	-5.446E+02	-50.3
8	14	-1.133E-02	-1.855E+02	-2.340E+02	2.334E+02	6.524E+02	-4.444E+02	-48.0
9	14	-1.054E-02	-1.510E+02	-1.913E+02	1.552E+02	6.092E+02	-3.277E+02	-48.7
10	14	-1.000E-02	-8.925E+01	-1.548E+02	9.705E+01	5.763E+02	-2.244E+02	-54.3
11	14	-9.529E-03	-2.944E+01	-1.299E+02	5.797E+01	5.484E+02	-1.563E+02	-65.4
12	14	-9.031E-03	8.140E-11	-6.000E+01	1.863E+01	2.601E+02	-6.531E+01	-74.1
0	15	-3.771E-02	3.429E-10	4.826E+02	9.328E+01	1.086E+03	5.000E+02	79.4
1	15	-3.655E-02	1.619E+03	1.602E+03	2.451E+02	2.106E+03	1.856E+03	44.0
2	15	-3.330E-02	-1.746E+02	5.445E+02	3.154E+02	1.918E+03	6.632F+02	69.4
3	15	-3.057E-02	-4.419E+01	5.407E+02	3.065E+02	1.761E+03	6.869E+02	64.5
4	15	-2.831E-02	2.153E+03	1.500E+03	4.334E+02	1.613E+03	2.369E+03	26.5
5	15	-2.237E-02	3.725E+02	4.247E+02	5.769E+02	1.288E+03	9.762E+02	46.3
6	15	-1.627E-02	-1.115E+00	-1.853E+01	4.908E+02	9.349E+02	-5.007E+02	-45.5
7	15	-1.425E-02	-2.424E+02	-1.170E+02	3.349E+02	8.229E+02	-5.256E+02	-39.8
8	15	-1.268E-02	-2.774E+02	-1.308E+02	2.508E+02	7.301E+02	-4.646E+02	-36.8
9	15	-1.149E-02	-2.232E+02	-1.130E+02	1.676E+02	6.617E+02	-3.445E+02	-35.9

10	15	-1.094E-02	-1.346E+02	-8.955E+01	1.031E+02	6.120E+02	-2.201E+02	-30.3
11	15	-4.943E-03	-5.637E+01	-7.217E+01	5.756E+01	5.751E+02	-1.224E+02	-40.9
12	15	-9.401E-03	-1.711E-11	-3.408E+01	1.670E+01	2.707E+02	-4.141E+01	-60.0
0	16	-4.463E-02	-3.769E-10	5.483E-10	2.705E+01	6.620E+02	2.705E+01	45.0
1	16	-4.242E-02	5.027E+02	7.021E-10	8.052E+01	1.236E+03	5.172E+02	9.5
2	16	-3.944E-02	-3.[illegible]7E+01	8.224E-10	1.120E+02	1.137E+03	-1.300E+02	-40.0
3	16	-3.615E-02	4.107E+01	5.462E-10	1.501E+02	1.041E+03	1.465E+02	37.4
4	16	-3.254E-02	7.772E+02	6.165E-10	1.895E+02	9.371E+02	8.210E+02	13.0
5	16	-2.824E-02	2.291E+02	4.541E-10	2.294E+02	7.557E+02	3.710E+02	31.7
6	16	-1.913E-02	-5.224E-01	1.746E-10	2.257E+02	5.510E+02	-2.260E+02	-45.0
7	16	-1.632E-02	-1.533E+02	1.642E-10	1.743E+02	4.717E+02	-2.071E+02	-33.1
8	16	-1.613E-02	-1.759E+02	1.371E-10	1.245E+02	4.070E+02	-2.412E+02	-27.3
9	16	-1.250E-02	-1.443E+02	1.157E-10	8.028E+01	3.594E+02	-1.801E+02	-24.0
10	16	-1.215E-02	-9.372E+01	4.275E-11	4.645E+01	3.272E+02	-1.128E+02	-22.4
11	16	-1.095E-02	-4.309E+01	6.601E-11	2.265E+01	3.034E+02	-5.340E+01	-23.0
12	16	-9.891E-03	1.713E-11	3.041E-11	5.891E+00	1.424E+02	5.891E+03	45.0

X , Y	DEFL	X MOMENT	Y MOMENT	XY TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL MOMENT	BETA X TO LARGEST

STATICS CHECK. ——SUMMATION OF REACTIONS = 1.362E+05

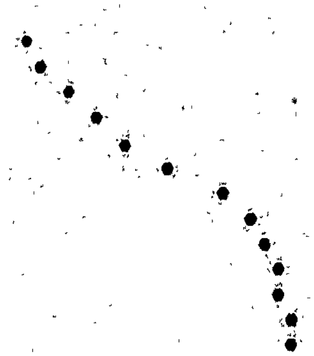
PROGRAM [illegible] [illegible] DECK-[illegible]-JJP,FLE REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE - 26 SEPT 70 - JJP,FLE,[illegible]
CONTRACT DACA 23-70-C-0070 UNITS ARE LBS AND INCHES

PROB (C)(III)
601/ [illegible] APPROACH SLAB (FROM REF 3, SIMILAR PROB IN REF 1)

TABLE 9. SELECTED OUTPUT.
X MOMENT ACTS IN THE X DIRECTION (ABOUT Y AXIS)

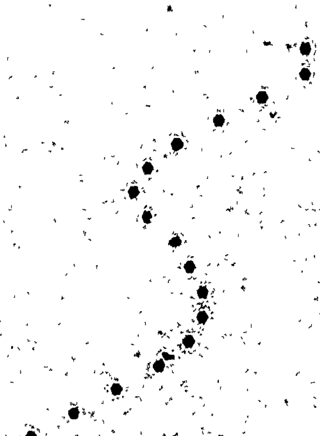
DEFLECTIONS, BETWEEN (0, 15) AND (12, 15)

X	Y	DEFLECTION
0	15	-3.771E-02
1	15	-3.650E-02
2	15	-3.[illegible]E-02
3	15	-3.[illegible]7E-02
4	15	-2.[illegible]1E-02
5	15	-2.237E-02
6	15	-1.827E-02
7	15	-1.[illegible]E-02
8	15	-1.26[illegible]E-02
9	15	-1.145E-02
10	15	-1.044E-02
11	15	-9.945E-03
12	15	-9.401E-03



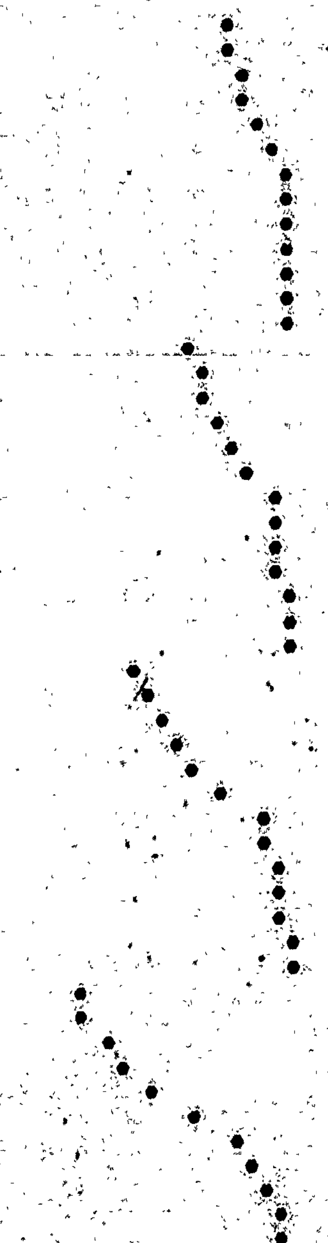
DEFLECTIONS, BETWEEN (4, 0) AND (4, 16)

X	Y	DEFLECTION
4	0	2.576E-27
4	1	-5.3[illegible]E-21
4	2	-[illegible].059E-03
4	3	-1.[illegible]9E-02
4	4	-1.6[illegible]E-02
4	5	-1.920E-02
4	6	-2.0[illegible]E-02
4	7	-1.928E-02
4	8	-1.5[illegible]E-02
4	9	-1.259E-02
4	10	-1.135E-02
4	11	-1.152E-02
4	12	-1.322E-02
4	13	-1.[illegible]E-02
4	14	-2.131E-02
4	15	-2.[illegible]E-02
4	16	-3.[illegible]E-02

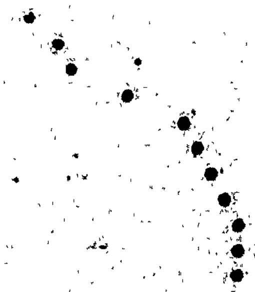


DEFLECTIONS BETWEEN (0, 12) AND (12, 16)

X	Y	DEFLECTION
0	12	-1.574E-02
1	12	-1.554E-02
2	12	-1.5[illegible]E-02
3	12	-1.461E-02
4	12	-1.372E-02
5	12	-1.[illegible]E-02
6	12	-9.955E-03
7	12	-9.865E-03
8	12	-9.793E-03
9	12	-9.704E-03
10	12	-9.592E-03
11	12	-9.346E-03
12	12	-9.026E-03
0	13	-2.139E-02
1	13	-2.093E-02
2	13	-1.974E-02
3	13	-1.836E-02
4	13	-1.666E-02
5	13	-1.415E-02
6	13	-1.1[illegible]E-02
7	13	-1.071E-02
8	13	-1.033E-02
9	13	-9.93[illegible]E-03
10	13	-9.602E-03
11	13	-9.247E-03
12	13	-8.868E-03
0	14	-2.913E-02
1	14	-2.813E-02
2	14	-2.617E-02
3	14	-2.40[illegible]E-02
4	14	-2.151E-02
5	14	-1.74[illegible]E-02
6	14	-1.341E-02
7	14	-1.21[illegible]E-02
8	14	-1.133E-02
9	14	-1.056E-02
10	14	-1.00[illegible]E-02
11	14	-9.520E-03
12	14	-9.031E-03
0	15	-3.771E-02
1	15	-3.658E-02
2	15	-3.330E-02
3	15	-3.05[illegible]E-02
4	15	-2.[illegible]E-02
5	15	-2.2[illegible]E-02
6	15	-1.627E-02
7	15	-1.42[illegible]E-02
8	15	-1.2[illegible]E-02
9	15	-1.1[illegible]E-02
10	15	-1.0[illegible]E-02
11	15	-9.9[illegible]E-03
12	15	-9.[illegible]E-03
0	16	-4.[illegible]E-02
1	16	-4.[illegible]E-02

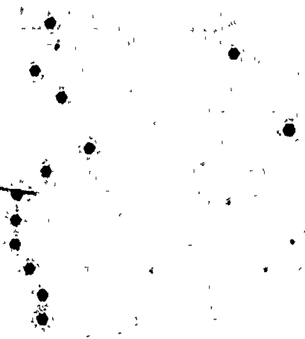


2	15	-1.9[illegible]E+02
3	16	-1.81[illegible]E+02
4	16	[illegible]E+02
5	16	-2.[illegible]E+02
6	16	-1.91[illegible]E+02
7	16	-1.61[illegible]E+02
8	16	-1.41[illegible]E+02
9	16	-1.25[illegible]E+02
10	16	-1.13[illegible]E+02
11	16	-1.03[illegible]E+02
12	16	-9.[illegible]E+01



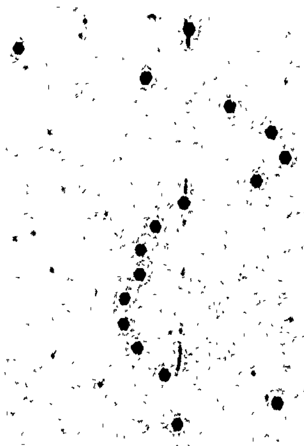
X MOMENTS ONLY, BETWEEN (0, 15) AND (12, 15)

X	Y	X MOMENT
0	15	3.429E-10
1	15	1.515E+03
2	15	-1.745E+02
3	15	4.415E+01
4	15	2.153E+03
5	15	3.722E+02
6	15	-1.115E+02
7	15	-2.424E+02
8	15	-2.774E+02
9	15	-2.232E+02
10	15	-1.346E+02
11	15	-5.637E+01
12	15	-1.711E-11



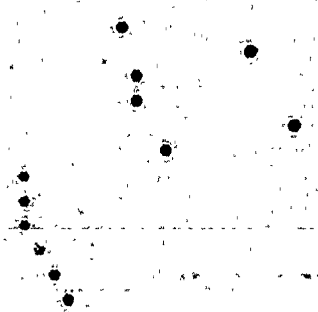
Y MOMENTS ONLY, BETWEEN (4, 0) AND (4, 16)

X	Y	Y MOMENT
4	0	-4.252E-13
4	1	-2.676E+03
4	2	-6.414E+02
4	3	4.835E+02
4	4	1.260E+03
4	5	1.436E+03
4	6	1.015E+03
4	7	7.452E-01
4	8	-5.347E+02
4	9	-7.512E+02
4	10	-8.944E+02
4	11	-9.682E+02
4	12	-1.002E+03
4	13	-9.071E+02
4	14	-6.646E+02
4	15	1.532E+03
4	16	6.145E-10



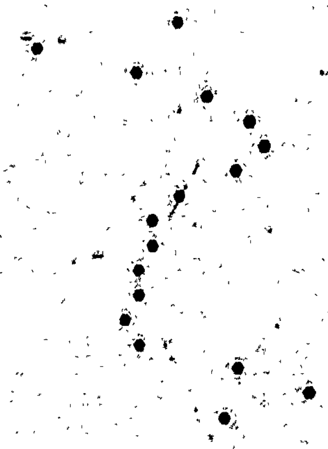
PRINCIPAL MOMENTS, BETWEEN (0, 15) AND (12, 15)

X , Y		MOMENT
0	15	5.601E+02
1	15	1.695E+03
2	15	6.612E+02
3	15	5.569E+02
4	15	2.369E+03
5	15	4.752E+02
6	15	-5.001E+02
7	15	-5.254E+02
8	15	[illegible]
9	15	-3.445E+02
10	15	-2.201E+02
11	15	-1.224E+02
12	15	-4.141E+01



PRINCIPAL MOMENTS, BETWEEN (4, 0) AND (4, 16)

X , Y		MOMENT
4	0	1.157E-22
4	1	-2.876E+03
4	2	-3.925E+02
4	3	4.853E+02
4	4	1.269E+03
4	5	1.438E+03
4	6	1.016E+03
4	7	-5.595E+01
4	8	-5.445E+02
4	9	-7.957E+02
4	10	-9.1[illegible]E+02
4	11	-1.014E+03
4	12	-1.047E+03
4	13	-1.034E+03
4	14	9.905E+02
4	15	2.349E+03
4	16	6.213E+02



TIME FOR THIS PROBLEM = 0 MINUTES 5.400 SECONDS

ELAPSED TIME = 0 MINUTES 15.643 SECONDS

```
PROGRAM SLAB-ONE CNAL SPECIAL OECR-AHE-JJP,FLE   REVISION DATE 07 SEP 70
    SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE         - 26 SEPT 70 - JJP,FLE,JLA
    CONTRACT DACA 23-70-C-0070                          UNITS ARE LBS AND INCHES

PR03
  JRS      4-25FT SQ TAXIWAY SLABS, 2 C-5A BOGIES CENTERED ON 25 PERCENT JOINTS
```

TABLE 1. CONTROL DATA.

```
     MULTIPLE LOAD OPTION (IF BLANK OR ZERO, PROB IS INDEPENDENT --        1
         IF +1, PARENT FOR NEXT PROB -- IF -1, AN OFFSPRING PROB)

                                                        TABLE NUMBER
                                                   2    3    4    5    6    7
     NUM CARDS INPUT THIS PROBLEM                  1    4    4    0    2    1

     COMPUTE OPTIONAL PAVEMENT STIFFNESS CONSTANTS  (1=YES)   DX,DY   C    S
                                                                1     1    1
     OPTION TO SUPRESS DETAILED OUTPUT (1=YES)                             1
     OPTION TO PRINT PRIN STRESS INSTEAD OF MOM (1=YES)                    1
```

TABLE 2. CONSTANTS—UNITS MUST BE CONSISTENT.

```
     NUM INCREMENTS IN X DIRECTION                                   20
     NUM INCREMENTS IN Y DIRECTION                                   20
     INCR LENGTH IN X DIRECTION                               3.000E+01
     INCR LENGTH IN Y DIRECTION                               2.150E+01
     POISSONS RATIO                                           2.000E-01
     MODULUS OF ELASTICITY                                    5.000E+06
     SLAB THICKNESS                                           1.200E+01
     SUBGRADE MODULUS                                         1.250E+02
```

TABLE 3. SPECIFIED AREAS FOR SELECTED PLOTTED OUTPUT.

```
                          PLOT  (1=YES)
  FROM    THRU          DEFL      X-MOMENT        Y-MOMENT   PRIN STRESS
  3  4  17  21            1          0               0           1
  0 20  20  21            1          1               0           0
  0 21  20  21            1          1               0           0
  9  0   9  26            1          0               1           0
```

TABLE 4. STIFFNESS AND LOAD DATA.

```
  FROM    THRU        DX            DY              Q          S          C

  10  0  10  26  -2.812E+05  -0.                   -0.        -0.        -0.
  10  1  10  27  -2.812E+05  -0.                   -0.        -0.        -0.
   0 14  20  14  -0.               -2.812E+04      -0.        -0.        -0.
   1 14  19  14  -0.               -2.812E+04      -0.        -0.        -0.
```

TABLE 4. (CONT'D) COMPUTED OPTIONAL PAVEMENT STIFFNESSES

FROM	THRU			DX	DY	S	C
1	1	20	26	0.	0.	0.	0.000E+00
0	0	20	26	1.875E+05	1.875E+05	2.016E+04	0.
1	0	17	26	1.875E+05	1.875E+05	2.016E+04	0.
0	1	20	27	1.875E+05	1.875E+05	2.016E+04	0.
1	1	39	27	1.875E+05	1.875E+05	2.016E+04	0.

TABLE 5. AXIAL THRUST DATA.

FROM THRU PX PY

NONE

TABLE 6. SPECIAL LOAD PATTERNS.

```
PATTERN   NUM OF            PATTERN COORDINATES AND CONCENTRATED LOADS
  NUM     LOADS     X    Y    X     Y    X     Y    X     Y    X     Y    X     Y
                 ---REFERENCE

   1        7       0    0   -2     1   -1     1    1     1    2     1   -1    -2
                         0  -30000     -30000     -30000     -30000     -30000
                    1   -2
                 -30000

   2        2       0    0   -3     0
                 -5000     -5000
```

TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS.

PATTERN NUM	NUM OF PLACEMENTS	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1	2	10	10	10	20										

(Location of reference load (slab coordinates) given in the X, Y column pairs.)

NUM OF WHEEL LOADS APPLIED TO THE SLAB = 14
SUM OF WHEEL LOADS APPLIED TO THE SLAB = -3.600E+05
NUM OF WHEEL LOADS PLACED OUTSIDE SLAB = 0
SUM OF WHEEL LOADS PLACED OUTSIDE SLAB = 0.

PROGRAM SLAB-49 CE-L SPECIAL DECK-AWE-JJP+FLE REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE - 26 SEPT 70 - JJP+FLE+JLR
CONTRACT DACA 39-70-C-0076 UNITS ARE LBS AND INCHES

PROB (CONT)
JRS 4-25FT SQ TAXIWAY SLABS, 2 C-5A BOGIES CENTERED ON 25 PERCENT JOINTS

TABLE 8. RESULTS.

X MOMENT AND X TWISTING MOMENT ACT IN THE X DIRECTION (ABOUT Y AXIS).
Y TWISTING MOMENT = -X TWISTING MOMENT. COUNTERCLOCKWISE BETA ANGLES
ARE POSITIVE FROM X AXIS TO THE DIRECTION OF LARGEST PRINCIPAL STRESS

X , Y	DEFL	X MOMENT	Y MOMENT	X TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL STRESS	BETA X TO LARGEST

*** THE DETAILED OUTPUT HAS BEEN DELETED BY THE OPTION IN TABLE 1.
A SINGLE SET OF VALUES IS PRINTED AT OR NEAR THE SLAB CENTER FOR REFERENCE

X , Y	DEFL	X MOMENT	Y MOMENT	X TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL STRESS	BETA X TO LARGEST
10 14	-3.037E-02	9.429E+02	-2.530E+03	-5.164E-11	2.448E+03	-1.054E+02	90.0

STATICS CHECK. SUMMATION OF REACTIONS = 3.600E+05

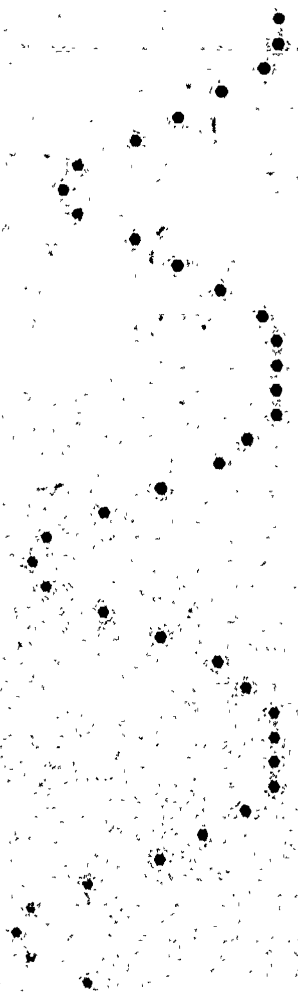
PROGRAM SLAB-30K CRKL SPECIAL DECK-AME-JJP,FLE   REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE   - 24 SEPT 70 - JJP,FLE,JCH
CONTRACT DACA 23-70-C-0076   UNITS ARE LBS AND INCHES

PROB (CO TO)
JMS   4-25FT SQ TAXIWAY SLABS, 2 C-5A BOGIES CENTERED ON 25 PERCENT JOINTS

TABLE 9. SELECTED OUTPUT.
A MOMENT ACTS IN THE X DIRECTION (ABOUT Y AXIS)

DEFLECTIONS, BETWEEN (3, 8) AND (17, 21).

X	Y	DEFLECTION
3	8	1.679E-04
4	8	-1.502E-03
5	8	-4.832E-03
6	8	-1.045E-02
7	8	-1.875E-02
8	8	-2.891E-02
9	8	-3.695E-02
10	8	-4.201E-02
11	8	-3.695E-02
12	8	-2.891E-02
13	8	-1.875E-02
14	8	-1.045E-02
15	8	-4.832E-03
16	8	-1.502E-03
17	8	1.679E-04
3	9	1.161E-04
4	9	-1.824E-03
5	9	-5.644E-03
6	9	-1.225E-02
7	9	-2.134E-02
8	9	-3.325E-02
9	9	-4.237E-02
10	9	-4.642E-02
11	9	-4.247E-02
12	9	-3.324E-02
13	9	-2.144E-02
14	9	-1.225E-02
15	9	-5.634E-03
16	9	-1.824E-03
17	9	1.161E-04
3	10	1.677E-04
4	10	-1.846E-03
5	10	-6.054E-03
6	10	-1.321E-02
7	10	-2.376E-02
8	10	-3.632E-02
9	10	-4.547E-02
10	10	-4.824E-02
11	10	-4.547E-02
12	10	-3.632E-02



13	10	-2.37[illegible]E-02
14	10	-1.321E-02
15	10	-5.0[illegible]E-03
16	10	-1.6[illegible]E-03
17	10	1.677E-04
3	11	4.04[illegible]E-04
4	11	-1.69[illegible]E-03
5	11	-5.613E-03
6	11	-1.302E-02
7	11	-2.3[illegible]E-02
8	11	-3.71[illegible]E-02
9	11	-4.5[illegible]E-02
10	11	-4.[illegible]51E-02
11	11	-4.5[illegible]E-02
12	11	-3.712E-02
13	11	-2.390E-02
14	11	-1.302E-02
15	11	-5.61[illegible]E-03
16	11	-1.652E-03
17	11	4.[illegible]E-04
3	12	7.742E-04
4	12	-1.099E-03
5	12	-4.932E-03
6	12	-1.152E-02
7	12	-2.113E-02
8	12	-3.232E-02
9	12	-4.001E-02
10	12	-4.337E-02
11	12	-4.001E-02
12	12	-3.232E-02
13	12	-2.113E-02
14	12	-1.152E-02
15	12	-4.932E-03
16	12	-1.094E-03
17	12	7.742E-04
3	13	1.233E-03
4	13	-3.403E-04
5	13	-3.612E-03
6	13	-9.260E-03
7	13	-1.725E-02
8	13	-2.621E-02
9	13	-3.244E-02
10	13	-3.555E-02
11	13	-3.244E-02
12	13	-2.621E-02
13	13	-1.725E-02
14	13	-9.2[illegible]E-03
15	13	-3.6[illegible]E-03
16	13	[illegible]
17	13	1.233E-03
3	14	1.701E-03
4	14	4.595E-04
5	14	-2.25[illegible]E-03
6	14	-6.[illegible]E-03
7	14	-1.[illegible]E-02
8	14	-2.077E-02
9	14	-2.675E-02
10	14	-3.037E-02
11	14	-2.675E-02
12	14	-2.077E-02

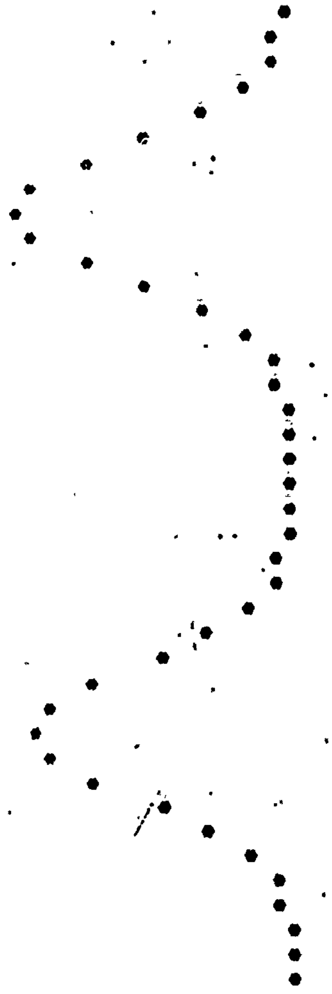
13	14	-1.3[illegible]-02
14	14	-[illegible]E-03
15	14	-2.2[illegible]-03
16	14	4.54[illegible]-04
17	14	1.7[illegible]1E-03
3	15	1.5[illegible]E-03
4	15	2.503E-04
5	15	-2.491E-03
6	15	-7.137E-03
7	15	-1.363E-02
8	15	-2.097E-02
9	15	-2.733E-02
10	15	-3.115E-02
11	15	-2.733E-02
12	15	-2.097E-02
13	15	-1.363E-02
14	15	-7.137E-03
15	15	-2.491E-03
16	15	2.503E-04
17	15	1.53[illegible]E-03
3	16	1.284E-03
4	16	-1.231E-04
5	16	-3.050E-03
6	16	-7.995E-03
7	16	-1.495E-02
8	16	-2.305E-02
9	16	-3.032E-02
10	16	-3.436E-02
11	16	-3.032E-02
12	16	-2.305E-02
13	16	-1.495E-02
14	16	-7.995E-03
15	16	-3.050E-03
16	16	-1.231E-04
17	16	1.2[illegible]E-03
3	17	9.623E-04
4	17	-6.40[illegible]E-04
5	17	-3.5[illegible]E-03
6	17	-9.398E-03
7	17	-1.727E-02
8	17	-2.670E-02
9	17	-3.544E-02
10	17	-3.952E-02
11	17	-3.544E-02
12	17	-2.670E-02
13	17	-1.727E-02
14	17	-[illegible].39[illegible]E-03
15	17	-3.49[illegible]E-03
16	17	-6.4[illegible]E-0[illegible]
17	17	[illegible].623E-04
3	18	5.980E-04
4	18	-1.230E-03
5	18	-4.492E-03
6	18	-1.104E-02
7	18	-2.004E-02
8	18	-3.093E-02
9	18	-[illegible].125E-02
10	18	-4.49[illegible]E-02
11	18	-[illegible].125E-02
12	18	-3.093E-02

13	18	-2.094E-02
14	18	-1.1[illegible]E-02
15	18	-4.842E-03
16	18	-1.230E-03
17	18	5.9[illegible]E-04
3	19	2.593E-04
4	19	-1.772E-03
5	19	-5.601E-03
6	19	-1.261E-02
7	19	-2.250E-02
8	19	-3.424E-02
9	19	-4.404E-02
10	19	-4.815E-02
11	19	-4.404E-02
12	19	-3.424E-02
13	19	-2.250E-02
14	19	-1.261E-02
15	19	-5.591E-03
16	19	-1.772E-03
17	19	2.503E-04
3	20	-2.079E-05
4	20	-2.155E-03
5	20	-6.371E-03
6	20	-1.355E-02
7	20	-2.407E-02
8	20	-3.657E-02
9	20	-4.562E-02
10	20	-4.927E-02
11	20	-4.562E-02
12	20	-3.657E-02
13	20	-2.407E-02
14	20	-1.355E-02
15	20	-6.371E-03
16	20	-2.155E-03
17	20	-2.079E-05
3	21	-1.603E-04
4	21	-2.251E-03
5	21	-6.372E-03
6	21	-1.341E-02
7	21	-2.339E-02
8	21	-3.679E-02
9	21	-4.492E-02
10	21	-4.741E-02
11	21	-4.492E-02
12	21	-3.679E-02
13	21	-2.339E-02
14	21	-1.341E-02
15	21	-6.372E-03
16	21	-2.251E-03
17	21	-1.693E-04

DEFLECTIONS, BETWEEN (0, 20) AND (20, 21)

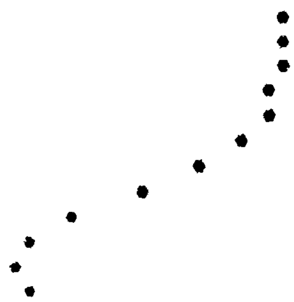
X , Y		DEFLECTION
0	20	1.335E-03
1	20	1.201E-03

2	20	6.833E-04
3	20	-2.079E-05
4	20	-2.155E-03
5	20	-6.371E-03
6	20	-1.355E-02
7	20	-2.407E-02
8	20	-3.657E-02
9	20	-4.556E-02
10	20	-4.927E-02
11	20	-4.556E-02
12	20	-3.657E-02
13	20	-2.407E-02
14	20	-1.355E-02
15	20	-6.371E-03
16	20	-2.155E-03
17	20	-2.079E-05
18	20	6.833E-04
19	20	1.201E-03
20	20	1.336E-03
0	21	1.163E-03
1	21	1.041E-03
2	21	7.294E-04
3	21	-1.603E-04
4	21	-2.251E-03
5	21	-6.372E-03
6	21	-1.341E-02
7	21	-2.354E-02
8	21	-3.676E-02
9	21	-4.492E-02
10	21	-4.741E-02
11	21	-4.492E-02
12	21	-3.676E-02
13	21	-2.336E-02
14	21	-1.341E-02
15	21	-6.372E-03
16	21	-2.251E-03
17	21	-1.603E-04
18	21	7.294E-04
19	21	1.041E-03
20	21	-1.163E-03



DEFLECTIONS, BETWEEN (0, 21) AND (20, 21)

X	Y	DEFLECTION
0	21	1.163E-03
1	21	1.041E-03
2	21	7.249E-04
3	21	-1.603E-04
4	21	-2.251E-03
5	21	-6.372E-03
6	21	-1.341E-02
7	21	-2.346E-02
8	21	-3.674E-02
9	21	-4.492E-02
10	21	-4.741E-02
11	21	-4.492E-02



12	21	-3.[illegible]E-02
13	21	-2.3[illegible]E-02
14	21	-1.341E-02
15	21	-6.377E-03
16	21	-2.251E-03
17	21	-1.603E-04
18	21	7.294E-04
19	21	1.041E-03
20	21	1.143E-03

DEFLECTIONS, BETWEEN (9, 0) AND (9, 28)

X	Y	DEFLECTION
9	0	4.326E-03
9	1	1.663E-03
9	2	-1.257E-03
9	3	-4.747E-03
9	4	-9.333E-03
9	5	-1.517E-02
9	6	-2.239E-02
9	7	-3.065E-02
9	8	-3.865E-02
9	9	-4.2[illegible]E-02
9	10	-4.547[illegible]-02
9	11	-4.[illegible]-02
9	12	-4.[illegible]-02
9	13	-3.[illegible]-02
9	14	-2.67[illegible]E-02
9	15	-2.73[illegible]E-02
9	16	-3.03[illegible]E-02
9	17	-[illegible].544E-02
9	18	-[illegible].126E-02
9	19	-4.404E-02
9	20	-4.562E-02
9	21	-4.492E-02
9	22	-3.613E-02
9	23	-2.946E-02
9	24	-2.092E-02
9	25	-1.33[illegible]E-02
9	26	-5.613E-03
9	27	-1.122E-03
9	28	4.141E-03

X MOMENTS ONLY, BETWEEN (0, 20) AND (20, 21)

X	Y	X MOMENT
0	20	-6.023E-11
1	20	-1.49[illegible]E+02
2	20	-4.70[illegible]E+02
3	20	-9.[illegible]E+02
4	20	-1.6[illegible]E+03
5	20	-2.2[illegible]E+03

6	20	-2.442E+03
7	20	-1.071E+03
8	20	3.572E+03
9	20	5.229E+03
10	20	1.755E+03
11	20	5.229E+03
12	20	3.572E+03
13	20	-1.071E+03
14	20	-2.442E+03
15	20	-2.263E+03
16	20	-1.644E+03
17	20	-9.623E+02
18	20	-4.790E+02
19	20	-1.459E+02
20	20	-2.435E-11
0	21	-1.044E-11
1	21	-1.455E+02
2	21	-4.566E+02
3	21	-9.471E+02
4	21	-1.544E+03
5	21	-2.212E+03
6	21	-2.415E+03
7	21	-1.121E+03
8	21	5.829E+03
9	21	6.649E+03
10	21	1.415E+03
11	21	6.649E+03
12	21	5.829E+03
13	21	-1.121E+03
14	21	-2.416E+03
15	21	-2.212E+03
16	21	-1.544E+03
17	21	-9.471E+02
18	21	-4.566E+02
19	21	-1.456E+02
20	21	-5.335E-12

X MOMENTS ONLY, BETWEEN (0, 21) AND (20, 21)

X	Y	X MOMENT
0	21	-1.084E-11
1	21	-1.456E+02
2	21	-4.566E+02
3	21	-9.471E+02
4	21	-1.544E+03
5	21	-2.212E+03
6	21	-2.415E+03
7	21	-1.121E+03
8	21	5.829E+03
9	21	6.649E+03
10	21	1.415E+03
11	21	6.649E+03
12	21	5.829E+03
13	21	-1.121E+03
14	21	-2.415E+03
15	21	-2.212E+03

16	21	-1.514E+03
17	21	-9.471E+02
18	21	-4.558E+02
19	21	-1.455E+02
20	21	-8.335E-12

Y MOMENTS ONLY, BETWEEN (9, 0) AND (9, 28)

X	, Y	Y MOMENT
9	0	-1.348E-10
9	1	-4.083E+02
9	2	-9.599E+02
9	3	-1.530E+03
9	4	-1.956E+03
9	5	-1.994E+03
9	6	-1.243E+03
9	7	1.101E+03
9	8	7.224E+03
9	9	3.531E+03
9	10	4.772E+03
9	11	1.053E+04
9	12	2.973E+03
9	13	-8.945E+02
9	14	-2.652E+03
9	15	-3.490E+03
9	16	-2.919E+03
9	17	-3.914E+02
9	18	6.102E+03
9	19	2.865E+03
9	20	4.589E+03
9	21	1.093E+04
9	22	3.730E+03
9	23	2.520E+02
9	24	-1.238E+03
9	25	-1.557E+03
9	26	-1.229E+03
9	27	-6.150E+02
9	28	-1.698E-10

PRINCIPAL STRESSES, BETWEEN (3, 8) AND (17, 21)

X	, Y	STRESS
3	8	-3.551E+01
4	8	-6.066E+01
5	8	-8.754E+01
6	8	-1.039E+02
7	8	-8.525E+01
8	8	1.331E+02
9	8	3.152E+02
10	8	2.147E+02
11	8	3.152E+02
12	8	1.331E+02

13	8	-[illegible].523E+01
14	8	-1.034E+02
15	8	-[illegible].758E+01
16	8	-6.066E+01
17	8	-3.551E+01
3	9	-3.858E+01
4	9	-6.534E+01
5	9	-9.254E+01
6	9	-1.036E+02
7	9	8.212E+01
8	9	1.137E+02
9	9	2.159E+02
10	9	1.837E+02
11	9	2.159E+02
12	9	1.137E+02
13	9	8.212E+01
14	9	-1.036E+02
15	9	-9.254E+01
16	9	-6.534E+01
17	9	-3.858E+01
3	10	-4.041E+01
4	10	-6.832E+01
5	10	-9.583E+01
6	10	-1.041E+02
7	10	1.141E+02
8	10	1.779E+02
9	10	2.326E+02
10	10	2.216E+02
11	10	2.326E+02
12	10	1.779E+02
13	10	1.141E+02
14	10	-1.041E+02
15	10	-9.583E+01
16	10	-6.832E+01
17	10	-4.041E+01
3	11	-4.087E+01
4	11	-6.925E+01
5	11	-9.745E+01
6	11	-1.075E+02
7	11	1.674E+02
8	11	4.153E+02
9	11	4.409E+02
10	11	3.043E+02
11	11	4.409E+02
12	11	4.153E+02
13	11	1.674E+02
14	11	-1.075E+02
15	11	-9.745E+01
16	11	-6.925E+01
17	11	-4.087E+01
3	12	-3.99[illegible]E+01
4	12	-[illegible].779E+01
5	12	-9.556E+01
6	12	-1.075E+02
7	12	1.047E+02
8	12	1.875E+02
9	12	1.713E+02
10	12	1.293E+02
11	12	1.713E+02
12	12	1.875E+02

13	12	1.047E+02
14	12	-1.075E+02
15	12	-9.556E+01
16	12	-6.779E+01
17	12	-3.992E+01
3	13	-3.784E+01
4	13	-6.433E+01
5	13	-9.092E+01
6	13	-1.055E+02
7	13	-9.319E+01
8	13	9.214E+01
9	13	9.807E+01
10	13	6.070E+01
11	13	9.807E+01
12	13	9.214E+01
13	13	-9.319E+01
14	13	-1.055E+02
15	13	-9.092E+01
16	13	-6.433E+01
17	13	-3.784E+01
3	14	-3.299E+01
4	14	-5.649E+01
5	14	-7.793E+01
6	14	-8.755E+01
7	14	-8.663E+01
8	14	-9.601E+01
9	14	-1.105E+02
10	14	-1.054E+02
11	14	-1.105E+02
12	14	-9.601E+01
13	14	-8.663E+01
14	14	-8.755E+01
15	14	-7.793E+01
16	14	-5.649E+01
17	14	-3.299E+01
3	15	-3.166E+01
4	15	-5.308E+01
5	15	-7.113E+01
6	15	-7.497E+01
7	15	-8.864E+01
8	15	-1.230E+02
9	15	-1.468E+02
10	15	-1.504E+02
11	15	-1.468E+02
12	15	-1.230E+02
13	15	-8.856E+01
14	15	-7.497E+01
15	15	-7.113E+01
16	15	-5.304E+01
17	15	-3.166E+01
3	16	-3.353E+01
4	16	-5.633E+01
5	16	-7.770E+01
6	16	-9.031E+01
7	16	-9.479E+01
8	16	-1.153E+02
9	16	-1.244E+02
10	16	-1.145E+02
11	16	-1.244E+02
12	16	-1.153E+02

13	16	-9.97[illegible]E+01
14	16	-9.031E+01
15	16	-7.77[illegible]E+01
16	16	-5.03[illegible]E+01
17	16	-3.35[illegible]E+01
3	17	-3.63[illegible]E+01
4	17	-6.123E+01
5	17	-9.5[illegible]E+01
6	17	-1.010E+02
7	17	-9.779E+01
8	17	-7.134E+01
9	17	1.5[illegible]E+02
10	17	7.903E+01
11	17	1.559E+02
12	17	-7.134E+01
13	17	-9.779E+01
14	17	-1.010E+02
15	17	-9.539E+01
16	17	-6.123E+01
17	17	-3.639E+01
3	18	-3.5[illegible]E+01
4	18	-6.546E+01
5	18	-9.173E+01
6	18	-1.048E+02
7	18	-8.242E+01
8	18	8.559E+01
9	18	2.773E+02
10	18	1.671E+02
11	18	2.773E+02
12	18	8.559E+01
13	18	-8.242E+01
14	18	-1.048E+02
15	18	-9.173E+01
16	18	-6.548E+01
17	18	-3.598E+01
3	19	-4.063E+01
4	19	-6.492E+01
5	19	-9.459E+01
6	19	-1.035E+02
7	19	-6.136E+01
8	19	8.279E+01
9	19	2.152E+02
10	19	1.533E+02
11	19	2.152E+02
12	19	8.279E+01
13	19	-5.136E+01
14	19	-1.035E+02
15	19	-9.459E+01
16	19	-6.802E+01
17	19	-4.053E+01
3	20	-4.046E+01
4	20	-6.552E+01
5	20	-9.522E+01
6	20	-1.022E+02
7	20	1.079E+02
8	20	1.691E+02
9	20	2.391E+02
10	20	2.141E+02
11	20	2.391E+02
12	20	1.691E+02

13	20	1.074E+02
14	20	-1.082E+02
15	20	-9.522E+01
16	20	-6.[illegible]2E+01
17	20	-4.0[illegible]E+01
3	21	-3.975E+01
4	21	-6.675E+01
5	21	-9.392E+01
6	21	-1.041E+02
7	21	1.740E+02
8	21	4.295E+02
9	21	4.594E+02
10	21	3.235E+02
11	21	4.564E+02
12	21	4.295E+02
13	21	1.740E+02
14	21	-1.041E+02
15	21	-9.392E+01
16	21	-6.075E+01
17	21	-3.975E+01

TIME FOR THIS PROBLEM = 0 MINUTES 22.583 SECONDS

ELAPSED TIME = 0 MINUTES 38.226 SECONDS

PROGRAM SLAB30E CERL SPECIAL DECK-AWE-JJP,FLE   REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE   - 24 SEPT 70 - JJP,FLE,JLR
CONTRACT DACA 23-70-C-0076   UNITS ARE LBS AND INCHES

PROB
JR6   4-25FT SQ TAXIWAY SLABS, 2 B-747 BOGIES, 25 PERCENT JOINTS

TABLE 1. CONTROL DATA.

MULTIPLE LOAD OPTION (IF BLANK OR ZERO, PROB IS INDEPENDENT -- IF +1, PARENT FOR NEXT PROB -- IF -1, AN OFFSPRING PROB)   -1

	TABLE NUMBER 2	3	4	5	6	7
NUM CARDS INPUT THIS PROBLEM	0	4	0	0	2	1

	DX,DY	C	S
COMPUTE OPTIONAL PAVEMENT STIFFNESS CONSTANTS (1=YES)	0	0	0
OPTION TO SUPRESS DETAILED OUTPUT (1=YES)			1
OPTION TO PRINT PRIN STRESS INSTEAD OF MOM (1=YES)			1

TABLE 2. CONSTANTS—UNITS MUST BE CONSISTENT.

NUM INCREMENTS IN X DIRECTION	20
NUM INCREMENTS IN Y DIRECTION	28
INCR LENGTH IN X DIRECTION	3.000E+01
INCR LENGTH IN Y DIRECTION	2.150E+01
POISSONS RATIO	2.000E-01
MODULUS OF ELASTICITY	5.000E+06
SLAB THICKNESS	1.200E+01
SUBGRADE MODULUS	1.250E+02

TABLE 3. SPECIFIED AREAS FOR SELECTED PLOTTED OUTPUT.

FROM		THRU		PLOT (1=YES) DEFL	X-MOMENT	Y-MOMENT	PRIN STRESS
3	8	17	21	1	0	0	1
0	21	20	21	1	1	0	0
9	0	9	28	1	0	1	0
12	0	12	28	1	0	1	0

TABLE 4. LOAD DATA—REPLACES LOAD IN PREVIOUS PROBLEM.

ALL STIFFNESS TERMS ARE RETAINED FROM PARENT PROBLEM   JR5

FROM   THRU   Q

NONE

TABLE 5. AXIAL THRUST DATA.

FROM	THRU	PX	PY
NONE			

TABLE 6. SPECIAL LOAD PATTERNS.

PATTERN NUM	NUM OF LOADS	PATTERN COORDINATES AND CONCENTRATED LOADS X (REFERENCE)	Y (REFERENCE)	X	Y	X	Y	X	Y	X	Y	X	Y
1	6	0	0	0	3	1	0	2	0	1	3	2	3
		-41500		-41500		-41500		-41500		-41500		-41500	
2	2	0	0	-3	0								
		-5000		-5000									

TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS.

PATTERN NUM	NUM OF PLACEMENTS	X	Y	LOCATION OF REFERENCE LOAD (SLAB COORDINATES) X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
1	2	7	12	12	18										

```
NUM OF WHEEL LOADS APPLIED TO THE SLAB   =          12
SUM OF WHEEL LOADS APPLIED TO THE SLAB   =  -4.980E+05
NUM OF WHEEL LOADS PLACED OUTSIDE SLAB   =           0
SUM OF WHEEL LOADS PLACED OUTSIDE SLAB   =   0.
```

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PROGRAM  SLAB-30  CERL SPECIAL DECK-ARE-JJP,FLE   REVISION DATE 07 SEP 70
     SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE        - 24 SEPT 70 - JJP,FLE,JLR
     CONTRACT DACA 23-70-C-0076                         UNITS ARE LBS AND INCHES


PROB (C) (D)
  JR6      4-25FT SQ TAXIWAY SLABS, 2 B-747 BOGIES, 25 PERCENT JOINTS
```

TABLE 8. RESULTS—USING STIFFNESS DATA FROM PARENT PROBLEM JR5.

```
            X MOMENT AND X TWISTING MOMENT ACT IN THE X DIRECTION (ABOUT Y AXIS),
            Y TWISTING MOMENT = -X TWISTING MOMENT, COUNTERCLOCKWISE BETA ANGLES
            ARE POSITIVE FROM X AXIS TO THE DIRECTION OF LARGEST PRINCIPAL STRESS

                                              X                     LARGEST    BETA
                       X           Y       TWISTING    SUPPORT    PRINCIPAL    X TO
 X , Y     DEFL      MOMENT      MOMENT     MOMENT     REACTION    STRESS    LARGEST


*** THE DETAILED OUTPUT HAS BEEN DELETED BY THE OPTION IN TABLE 1.
    A SINGLE SET OF VALUES IS PRINTED AT OR NEAR THE SLAB CENTER FOR REFERENCE

10  14 -5.735E-02 -2.460E+01  2.178E+03 -2.165E+03  4.622E+03  1.461E+02 -58.5

                                              X                     LARGEST    BETA
                       X           Y       TWISTING    SUPPORT    PRINCIPAL    X TO
 X , Y     DEFL      MOMENT      MOMENT     MOMENT     REACTION    STRESS    LARGEST


STATICS CHECK.          SUMMATION OF REACTIONS =     4.980E+05
```

PROGRAM SLAB30E CE-L SPECIAL DECK-ARE-JJP+FLE   REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE   - 24 SEPT 70 - JJP+FLE+JLP
CONTRACT DACA 23-70-C-0076   UNITS ARE LBS AND INCHES

PROB (CO TD)
JR6   4-25FT SQ TAXIWAY SLABS, 2 B-747 BOGIES, 25 PERCENT JOINTS

TABLE 9. SELECTED OUTPUT—USING STIFFNESS DATA FROM PARENT PROBLEM JR5.
X MOMENT ACTS IN THE X DIRECTION (ABOUT Y AXIS)

DEFLECTIONS, BETWEEN (3, 8) AND (17, 21)

X	Y	DEFLECTION
3	8	-4.619E-04
4	8	-3.236E-03
5	8	-7.197E-03
6	8	-1.199E-02
7	8	-1.592E-02
8	8	-1.740E-02
9	8	-1.554E-02
10	8	-1.116E-02
11	8	-6.516E-03
12	8	-2.666E-03
13	8	-1.019E-04
14	8	1.286E-03
15	8	1.835E-03
16	8	1.890E-03
17	8	1.725E-03
3	9	-1.638E-03
4	9	-5.698E-03
5	9	-1.160E-02
6	9	-1.840E-02
7	9	-2.525E-02
8	9	-2.773E-02
9	9	-2.495E-02
10	9	-1.829E-02
11	9	-1.127E-02
12	9	-5.577E-03
13	9	-1.607E-03
14	9	3.703E-04
15	9	1.430E-03
16	9	1.820E-03
17	9	1.87[illegible]E-03
3	10	-3.035E-03
4	10	-8.549E-03
5	10	-1.680E-02
6	10	-2.720E-02
7	10	-3.703E-02
8	10	-4.091E-02
9	10	-3.693E-02
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11	10	-1.71[illegible]E-02
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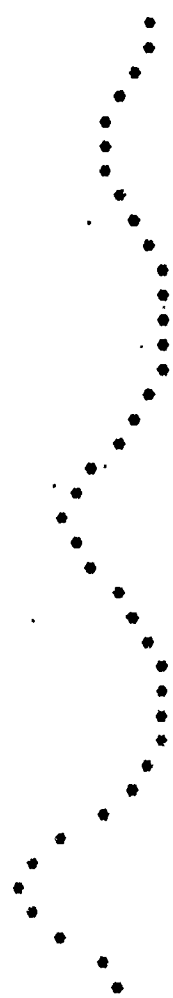

13	10	-4.272E-03
14	10	-1.157E-03
15	10	5.037E-04
16	10	1.451E-03
17	10	1.475E-03
3	11	-4.491E-03
4	11	-1.152E-02
5	11	-2.214E-02
6	11	-3.620E-02
7	11	-5.032E-02
8	11	-5.594E-02
9	11	-5.056E-02
10	11	-3.644E-02
11	11	-2.396E-02
12	11	-1.413E-02
13	11	-7.608E-03
14	11	-3.502E-03
15	11	-9.256E-04
16	11	6.595E-04
17	11	1.622E-03
3	12	-5.742E-03
4	12	-1.411E-02
5	12	-2.645E-02
6	12	-4.410E-02
7	12	-6.259E-02
8	12	-6.949E-02
9	12	-6.342E-02
10	12	-4.592E-02
11	12	-3.054E-02
12	12	-1.945E-02
13	12	-1.193E-02
14	12	-6.832E-03
15	12	-3.224E-03
16	12	-6.791E-04
17	12	1.053E-03
3	13	-5.731E-03
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10	13	-5.244E-02
11	13	-3.688E-02
12	13	-2.540E-02
13	13	-1.737E-02
14	13	-1.135E-02
15	13	-6.442E-03
16	13	-2.670E-03
17	13	9.423E-05
3	14	-7.144E-03
4	14	-1.675E-02
5	14	-3.163E-02
6	14	-5.134E-02
7	14	-7.145E-02
8	14	-8.025E-02
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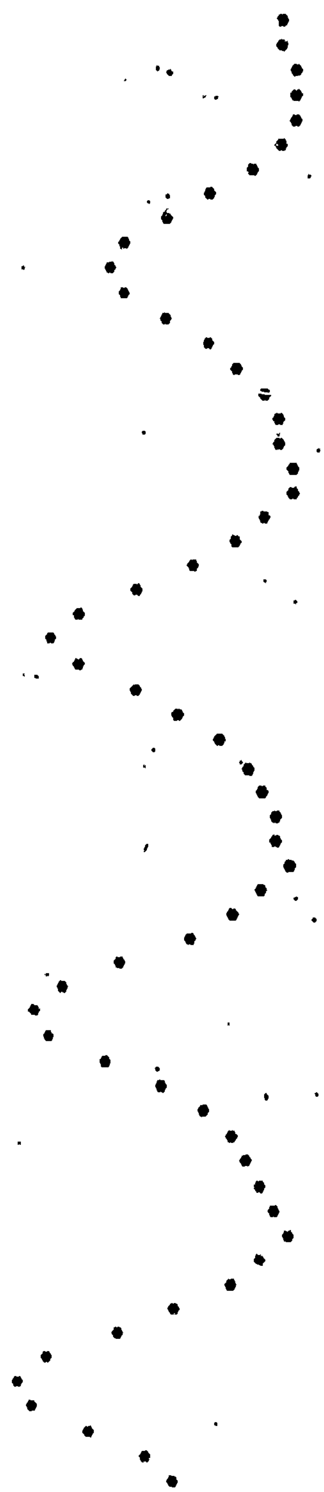
12	14	-3.145E-02



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14	14	-1.719E-02
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3	15	-6.006E-03
4	15	-1.451E-02
5	15	-2.790E-02
6	15	-4.590E-02
7	15	-6.558E-02
8	15	-7.462E-02
9	15	-7.059E-02
10	15	-5.651E-02
11	15	-4.716E-02
12	15	-4.103E-02
13	15	-3.534E-02
14	15	-2.836E-02
15	15	-1.921E-02
16	15	-1.099E-02
17	15	-4.632E-03
3	16	-4.454E-03
4	16	-1.164E-02
5	16	-2.270E-02
6	16	-3.754E-02
7	16	-5.323E-02
8	16	-6.162E-02
9	16	-6.072E-02
10	16	-5.334E-02
11	16	-5.100E-02
12	16	-5.045E-02
13	16	-4.822E-02
14	16	-4.035E-02
15	16	-2.840E-02
16	16	-1.645E-02
17	16	-8.124E-03
3	17	-2.773E-03
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6	17	-2.825E-02
7	27	-4.004E-02
8	17	-4.752E-02
9	17	-4.477E-02
10	17	-4.890E-02
11	17	-5.437E-02
12	17	-6.128E-02
13	17	-6.144E-02
14	17	-5.327E-02
15	17	-3.752E-02
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17	17	-1.141E-02
3	18	-1.197E-03
4	18	-5.258E-03
5	18	-1.148E-02
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7	18	-2.843E-02
8	18	-3.528E-02
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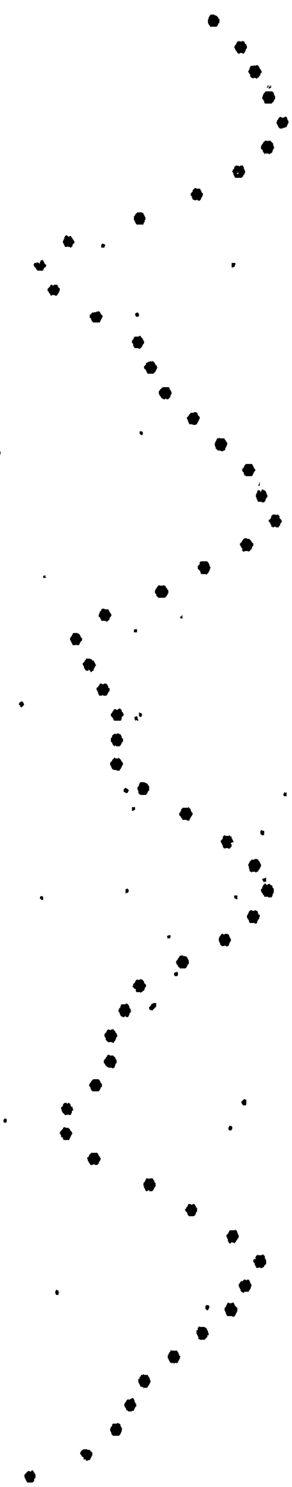

13	18	-7.340E-02
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15	18	-4.445E-02
16	18	-2.715E-02
17	18	-1.409E-02
3	19	9.574E-05
4	19	-2.635E-03
5	19	-6.957E-03
6	19	-1.251E-02
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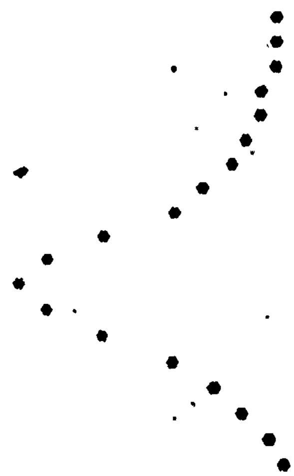
8	19	-2.531E-02
9	19	-3.147E-02
10	19	-3.695E-02
11	19	-5.443E-02
12	19	-7.046E-02
13	19	-7.613E-02
14	19	-6.748E-02
15	19	-4.820E-02
16	19	-2.956E-02
17	19	-1.549E-02
3	20	1.022E-03
4	20	-6.532E-04
5	20	-3.396E-03
6	20	-7.268E-03
7	20	-1.209E-02
8	20	-1.796E-02
9	20	-2.449E-02
10	20	-3.360E-02
11	20	-5.151E-02
12	20	-6.901E-02
13	20	-7.533E-02
14	20	-6.729E-02
15	20	-4.831E-02
16	20	-2.978E-02
17	20	-1.572E-02
3	21	1.579E-03
4	21	6.865E-04
5	21	-9.373E-04
6	21	-3.481E-03
7	21	-7.043E-03
8	21	-1.186E-02
9	21	-1.856E-02
10	21	-2.791E-02
11	21	-4.594E-02
12	21	-6.429E-02
13	21	-7.132E-02
14	21	-6.375E-02
15	21	-4.519E-02
16	21	-2.741E-02
17	21	-1.469E-02

DEFLECTIONS, BETWEEN (0, 21) AND (20, 21)

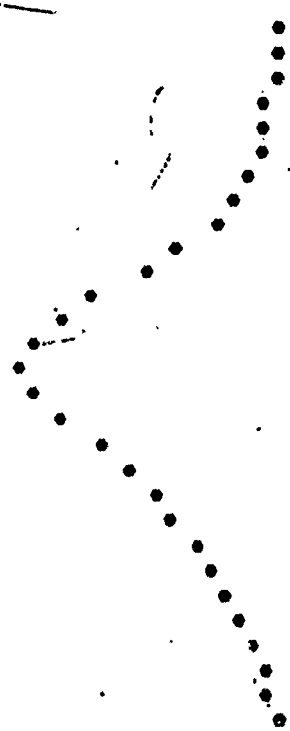
X , Y		DEFLECTION
0	21	2.663E-03
1	21	2.325E-03

2	21	2.027E-03	
3	21	1.574E-03	
4	21	6.606E-04	
5	21	-9.373E-04	
6	21	-3.451E-03	
7	21	-7.049E-03	
8	21	-1.196E-02	
9	21	-1.956E-02	
10	21	-2.791E-02	
11	21	-4.594E-02	
12	21	-6.429E-02	
13	21	-7.102E-02	
14	21	-6.375E-02	
15	21	-4.519E-02	
16	21	-2.741E-02	
17	21	-1.469E-02	
18	21	-5.681E-03	
19	21	5.719E-04	
20	21	5.633E-03	



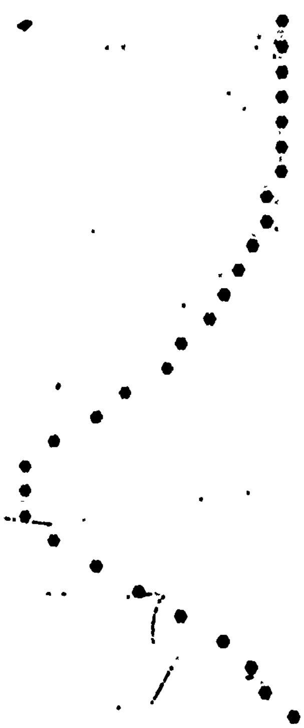
DEFLECTIONS, BETWEEN (9, 0) AND (9, 28)

X	Y	DEFLECTION
9	0	2.051E-03
9	1	1.937E-03
9	2	1.756E-03
9	3	1.357E-03
9	4	4.935E-04
9	5	-1.172E-03
9	6	-4.069E-03
9	7	-8.692E-03
9	8	-1.554E-02
9	9	-2.496E-02
9	10	-3.693E-02
9	11	-5.059E-02
9	12	-6.342E-02
9	13	-6.971E-02
9	14	-7.430E-02
9	15	-7.069E-02
9	16	-6.072E-02
9	17	-4.977E-02
9	18	-3.985E-02
9	19	-3.147E-02
9	20	-2.449E-02
9	21	-1.856E-02
9	22	-1.339E-02
9	23	-8.739E-03
9	24	-4.699E-03
9	25	-1.161E-03
9	26	2.033E-03
9	27	5.041E-03
9	28	8.191E-03



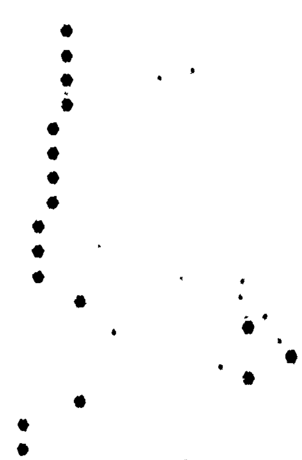
DEFLECTIONS, BETWEEN (12, 0) AND (12, 28)

X	Y	DEFLECTION
12	0	1.240E-03
12	1	1.394E-03
12	2	1.547E-03
12	3	1.657E-03
12	4	1.639E-03
12	5	1.363E-03
12	6	6.703E-04
12	7	-6.177E-04
12	8	-2.668E-03
12	9	-5.597E-03
12	10	-9.434E-03
12	11	-1.410E-02
12	12	-1.945E-02
12	13	-2.540E-02
12	14	-3.195E-02
12	15	-4.103E-02
12	16	-5.095E-02
12	17	-6.128E-02
12	18	-6.982E-02
12	19	-7.086E-02
12	20	-6.901E-02
12	21	-6.426E-02
12	22	-5.219E-02
12	23	-3.869E-02
12	24	-2.633E-02
12	25	-1.594E-02
12	26	-7.427E-03
12	27	-2.628E-04
12	28	6.223E-03



X MOMENTS ONLY, BETWEEN (0, 21) AND (28, 21)

X	Y	X MOMENT
0	21	1.594E-11
1	21	9.242E+00
2	21	-1.780E+02
3	21	-4.721E+02
4	21	-7.867E+02
5	21	-1.050E+03
6	21	-1.257E+03
7	21	-1.527E+03
8	21	-2.015E+03
9	21	-2.444E+03
10	21	-1.766E+03
11	21	7.246E+02
12	21	1.206E+04
13	21	1.450E+04
14	21	1.144E+04
15	21	2.841E+02
16	21	-2.859E+03
17	21	-3.055E+03



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19  21 -2.174E+03
19  21 -9.071E+02
20  21 -6.935E-12
```

Y MOMENTS ONLY, BETWEEN (9, 0) AND (9, 28)

```
X , Y   Y MOMENT

9   0 -6.082E-11
9   1 -1.135E+02
9   2 -3.536E+02
9   3 -7.315E+02
9   4 -1.254E+03
9   5 -1.908E+03
9   6 -2.645E+03
9   7 -3.343E+03
9   8 -3.763E+03
9   9 -3.478E+03
9  10 -1.757E+03
9  11  2.694E+03
9  12  1.248E+04
9  13  4.574E+03
9  14  3.787E+03
9  15  1.194E+04
9  16  2.674E+03
9  17 -1.186E+03
9  18 -2.395E+03
9  19 -2.503E+03
9  20 -2.100E+03
9  21 -1.603E+03
9  22 -1.376E+03
9  23 -1.255E+03
9  24 -1.056E+03
9  25 -7.294E+02
9  26 -3.433E+02
9  27 -3.754E+01
9  28 -3.203E-10
```

Y MOMENTS ONLY, BETWEEN (12, 0) AND (12, 28)

```
X , Y   Y MOMENT

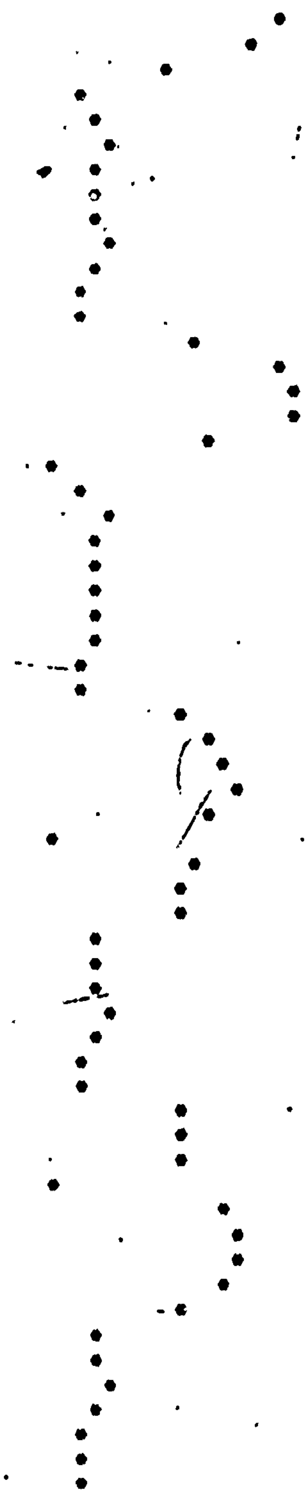
12   0 -3.007E-11
12   1 -3.912E+00
12   2 -7.926E+01
12   3 -2.275E+02
12   4 -4.474E+02
12   5 -7.302E+02
12   6 -1.053E+03
12   7 -1.376E+03
12   8 -1.641E+03
12   9 -1.745E+03
12  10 -1.774E+03
12  11 -1.444E+03
```

12	12	-1.504E+03
12	13	-1.594E+03
12	14	-[illegible].146E+03
12	15	-[illegible].433E+03
12	16	-2.226E+02
12	17	3.950E+03
12	18	1.345E+04
12	19	6.475E+03
12	20	6.514E+03
12	21	1.349E+04
12	22	3.747E+03
12	23	-7.725E+02
12	24	-2.447E+03
12	25	-2.554E+03
12	26	-1.877E+03
12	27	-9.152E+02
12	28	-6.017E-11

PRINCIPAL STRESSES, BETWEEN (3, 8) AND (17, 21)

X	Y	STRESS
3	8	-6.978E+01
4	8	-1.036E+02
5	8	-1.343E+02
6	8	-1.551E+02
7	8	-1.658E+02
8	8	-1.692E+02
9	8	-1.693E+02
10	8	-1.641E+02
11	8	-1.435E+02
12	8	-1.156E+02
13	8	-8.544E+01
14	8	-5.851E+01
15	8	-3.719E+01
16	8	-2.134E+01
17	8	-1.040E+01
3	9	-8.547E+01
4	9	-1.246E+02
5	9	-1.559E+02
6	9	-1.667E+02
7	9	-1.639E+02
8	9	-1.554E+02
9	9	-1.651E+02
10	9	-1.759E+02
11	9	-1.650E+02
12	9	-1.349E+02
13	9	-1.053E+02
14	9	-7.659E+01
15	9	-5.244E+01
16	9	-3.325E+01
17	9	-1.259E+01
3	10	-9.955E+01
4	10	-1.422E+02
5	10	-1.632E+02
6	10	-1.546E+02
7	10	2.242E+02

8	10	2.479E+02
9	10	2.105E+02
10	10	-1.605E+02
11	10	-1.745E+02
12	10	-1.542E+02
13	10	-1.233E+02
14	10	-9.445E+01
15	10	-6.975E+01
16	10	-4.773E+01
17	10	-2.934E+01
3	11	-1.102E+02
4	11	-1.545E+02
5	11	-1.693E+02
6	11	1.954E+02
7	11	3.664E+02
8	11	3.964E+02
9	11	3.435E+02
10	11	1.479E+02
11	11	-1.659E+02
12	11	-1.582E+02
13	11	-1.324E+02
14	11	-1.102E+02
15	11	-8.828E+01
16	11	-6.405E+01
17	11	-4.227E+01
3	12	-1.137E+02
4	12	-1.611E+02
5	12	-1.634E+02
6	12	2.419E+02
7	12	5.883E+02
8	12	6.229E+02
9	12	5.464E+02
10	12	1.859E+02
11	12	-1.464E+02
12	12	-1.471E+02
13	12	-1.295E+02
14	12	-1.215E+02
15	12	-1.055E+02
16	12	-8.291E+01
17	12	-5.699E+01
3	13	-1.231E+02
4	13	-1.631E+02
5	13	-1.486E+02
6	13	1.594E+02
7	13	4.173E+02
8	13	5.312E+02
9	13	4.014E+02
10	13	1.093E+02
11	13	-1.361E+02
12	13	-1.295E+02
13	13	-1.127E+02
14	13	-1.256E+02
15	13	-1.212E+02
16	13	-1.009E+02
17	13	-7.251E+01
3	14	-1.297E+02
4	14	-1.737E+02
5	14	-1.528E+02
6	14	1.317E+02
7	14	4.249E+02

8	14	5.442E+02	
9	14	4.212E+02	
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12	14	-1.573E+02	
13	14	-9.430E+01	
14	14	-1.15[illegible]E+02	
15	14	-1.41[illegible]E+02	
16	14	-1.322E+02	
17	14	-1.010E+02	
3	15	-1.251E+02	
4	15	-1.710E+02	
5	15	-1.73[illegible]E+02	
6	15	2.235E+02	
7	15	5.381E+02	
8	15	6.172E+02	
9	15	6.141E+02	
10	15	3.019E+02	
11	15	-2.762E+02	
12	15	-1.975E+02	
13	15	-1.00[illegible]E+02	
14	15	-1.124E+02	
15	15	-1.570E+02	
16	15	-1.543E+02	
17	15	-1.254E+02	
3	16	-1.177E+02	
4	16	-1.657E+02	
5	16	-1.849E+02	
6	16	1.652E+02	
7	16	3.059E+02	
8	16	3.450E+02	
9	16	3.723E+02	
10	16	2.926E+02	
11	16	-2.954E+02	
12	16	2.305E+02	
13	16	1.799E+02	
14	16	1.668E+02	
15	16	-1.342E+02	
16	16	-1.637E+02	
17	16	-1.360E+02	
3	17	-1.065E+02	
4	17	-1.540E+02	
5	17	-1.84[illegible]E+02	
6	17	-1.710E+02	
7	17	1.550E+02	
8	17	1.719E+02	
9	17	2.008E+02	
10	17	-2.737E+02	
11	17	3.0[illegible]E+02	
12	17	4.02[illegible]E+02	
13	17	3.50[illegible]E+02	
14	17	3.219E+02	
15	17	2.011E+02	
16	17	-1.5[illegible]E+02	
17	17	-1.421E+02	
3	18	-9.21[illegible]E+01	
4	18	-1.353E+02	
5	18	-1.72[illegible]E+02	
6	18	-1.8[illegible]E+02	
7	18	-1.633E+02	

8	18	-1.503E+02
9	18	-1.615E+02
10	18	-2.15[illegible]E+02
11	18	3.19[illegible]E+02
12	18	6.60[illegible]E+02
13	18	6.942E+02
14	18	5.117E+02
15	18	2.743E+02
16	18	-1.457E+02
17	18	-1.423E+02
3	19	-7.591E+01
4	19	-1.147E+02
5	19	-1.5[illegible]E+02
6	19	-1.72[illegible]E+02
7	19	-1.71[illegible]E+02
8	19	-1.554E+02
9	19	-1.562E+02
10	19	-1.457E+02
11	19	1.940E+02
12	19	4.343E+02
13	19	5.37[illegible]E+02
14	19	4.167E+02
15	19	2.148E+02
16	19	-1.299E+02
17	19	-1.404E+02
3	20	-5.912E+01
4	20	-9.145E+01
5	20	-1.242E+02
6	20	-1.455E+02
7	20	-1.547E+02
8	20	-1.355E+02
9	20	-1.141E+02
10	20	-9.015E+01
11	20	1.642E+02
12	20	4.352E+02
13	20	5.495E+02
14	20	4.285E+02
15	20	2.173E+02
16	20	-1.272E+02
17	20	-1.392E+02
3	21	-4.335E+01
4	21	-6.695E+01
5	21	-9.672E+01
6	21	-1.201E+02
7	21	-1.310E+02
8	21	-1.222E+02
9	21	-1.043E+02
10	21	-8.203E+01
11	21	2.144E+02
12	21	5.[illegible]E+02
13	21	6.904E+02
14	21	6.345E+02
15	21	2.6[illegible]E+02
16	21	-1.37[illegible]E+02
17	21	-1.3[illegible]2E+02

TIME FOR THIS PROBLEM = 0 MINUTES 6.726 SECONDS

ELAPSED TIME = 0 MINUTES 44.952 SECONDS

```
PROGRAM SLAB [illegible] CERL SPECIAL DECK-ARE-JJP,FLE   REVISION DATE 07 SEP 70
     SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE        - 24 SEPT 70 - JJP,FLE,JLR
     CONTRACT DACA 23-70-C-0076                          UNITS ARE LBS AND INCHES


PROB
 SACI      8 X 8  REG
```

TABLE 1. CONTROL DATA.

MULTIPLE LOAD OPTION (IF BLANK OR ZERO, PROB IS INDEPENDENT -- IF +1, PARENT FOR NEXT PROB -- IF -1, AN OFFSPRING PROB)						-0
	TABLE NUMBER					
	2	3	4	5	6	7
NUM CARDS INPUT THIS PROBLEM	1	0	6	0	0	0
COMPUTE OPTIONAL PAVEMENT STIFFNESS CONSTANTS (1=YES)				DX,DY	C	S
				0	0	0
OPTION TO SUPRESS DETAILED OUTPUT (1=YES)						0
OPTION TO PRINT PRIN STRESS INSTEAD OF MOM (1=YES)						0

TABLE 2. CONSTANTS—UNITS MUST BE CONSISTENT.

NUM INCREMENTS IN X DIRECTION	8
NUM INCREMENTS IN Y DIRECTION	8
INCR LENGTH IN X DIRECTION	6.000E+00
INCR LENGTH IN Y DIRECTION	6.000E+00
POISSONS RATIO	2.500E-01
MODULUS OF ELASTICITY	0.
SLAB THICKNESS	9.788E-01
SUBGRADE MODULUS	0.

TABLE 3. SPECIFIED AREAS FOR SELECTED PLOTTED OUTPUT.

FROM	THRU	PLOT (1=YES) DEFL	X-MOMENT	Y-MOMENT	PRIN MOMENT

NONE

TABLE 4. STIFFNESS AND LOAD DATA.

FROM		THRU		DX	DY	Q	S	C
0	0	3	6	6.250E+05	6.250E+05	-0.	1.000E+20	-0.
1	0	7	5	6.250E+05	6.250E+05	-0.	-0.	-0.
0	1	8	7	6.250E+05	6.250E+05	-0.	-0.	-0.
1	1	7	7	6.250E+05	6.250E+05	-0.	-1.000E+20	-0.
4	4	4	4	-0.	-0.	-1.000E+05	-0.	-0.
1	1	8	8	-0.	-0.	-0.	-0.	1.875E+06

TABLE 5. AXIAL THRUST DATA.

FROM	THRU	PX	PY
NONE			

TABLE 6. SPECIAL LOAD PATTERNS.

NONE

TABLE 7. PLACEMENTS OF SPECIAL LOAD PATTERNS.

NONE

PROGRAM SLA-30E CERL SPECIAL DECK-ARE-JJP,FLE   REVISION DATE 07 SEP 70
SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE   - 24 SEPT 70 - JJP,FLE,JLR
CONTRACT DACA 23-70-C-0076   UNITS ARE LBS AND INCHES

PROB (CONTD)
SAC1 8 X 5 REG

TABLE 8. RESULTS.

X MOMENT AND X TWISTING MOMENT ACT IN THE X DIRECTION (ABOUT Y AXIS), Y TWISTING MOMENT = -X TWISTING MOMENT, COUNTERCLOCKWISE BETA ANGLES ARE POSITIVE FROM X AXIS TO THE DIRECTION OF LARGEST PRINCIPAL MOMENT

X	Y	DEFL	X MOMENT	Y MOMENT	X TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL MOMENT	BETA X TO LARGEST
0	0	1.267E-16	7.190E-26	-1.233E-25	-1.584E+03	-1.267E+04	-1.584E+03	45.0
1	0	-2.275E-17	-3.390E-12	-2.976E-11	-3.013E+03	2.275E+03	-3.013E+03	45.0
2	0	-4.779E-17	-1.544E-11	-6.168E-11	-2.490E+03	4.779E+03	-2.490E+03	45.0
3	0	-7.350E-17	-3.047E-11	-1.233E-10	-1.480E+03	7.350E+03	-1.480E+03	45.0
4	0	-8.864E-17	-2.979E-11	-1.231E-10	-6.129E-10	8.864E+03	-6.912E-10	47.2
5	0	-7.350E-17	-3.047E-11	-1.233E-10	1.480E+03	7.350E+03	-1.480E+03	-45.0
6	0	-4.779E-17	-1.544E-11	-6.168E-11	2.490E+03	4.779E+03	-2.490E+03	-45.0
7	0	-2.275E-17	-3.390E-12	-2.976E-11	3.013E+03	2.275E+03	-3.013E+03	-45.0
8	0	1.267E-16	7.533E-26	-1.096E-25	1.584E+03	-1.267E+04	-1.584E+03	-45.0
0	1	-2.275E-17	-6.060E-11	-1.110E-11	-3.013E+03	2.275E+03	-3.013E+03	45.0
1	1	-1.216E-01	1.034E+03	1.034E+03	-5.773E+03	0.	6.807E+03	-45.0
2	1	-2.314E-01	2.297E+03	1.839E+03	-4.682E+03	0.	6.956E+03	-43.7
3	1	-3.129E-01	3.766E+03	2.209E+03	-3.016E+03	0.	6.102E+03	-37.8
4	1	-3.451E-01	4.728E+03	2.165E+03	-1.203E-09	0.	4.728E+03	-.0
5	1	-3.129E-01	3.766E+03	2.209E+03	3.016E+03	0.	6.102E+03	37.8
6	1	-2.314E-01	2.297E+03	1.839E+03	4.682E+03	0.	6.956E+03	43.7
7	1	-1.216E-01	1.034E+03	1.034E+03	5.773E+03	0.	6.807E+03	45.0
8	1	-2.275E-17	4.734E-11	1.589E-11	3.013E+03	2.275E+03	3.013E+03	45.0
0	2	-4.779E-17	-6.168E-11	-1.544E-11	-2.490E+03	4.779E+03	-2.490E+03	45.0
1	2	-2.314E-01	1.839E+03	2.297E+03	-4.682E+03	0.	6.956E+03	-46.3
2	2	-4.433E-01	4.251E+03	4.251E+03	-4.449E+03	0.	8.700E+03	-45.0
3	2	-5.063E-01	7.486E+03	5.382E+03	-3.155E+03	0.	9.759E+03	-35.8
4	2	-6.750E-01	1.028E+04	5.347E+03	-1.203E-09	0.	1.028E+04	-.0
5	2	-6.063E-01	7.486E+03	5.382E+03	3.155E+03	0.	9.759E+03	35.8
6	2	-4.433E-01	4.251E+03	4.251E+03	4.449E+03	0.	8.700E+03	45.0
7	2	-2.314E-01	1.839E+03	2.297E+03	4.682E+03	0.	6.956E+03	46.3
8	2	-4.779E-17	3.063E-11	7.680E-12	2.490E+03	4.779E+03	2.490E+03	45.0
0	3	-7.350E-17	-1.233E-10	-3.047E-11	-1.480E+03	7.350E+03	-1.480E+03	45.0
1	3	-3.129E-01	2.209E+03	3.766E+03	-3.016E+03	0.	6.102E+03	-52.2
2	3	-6.063E-01	5.382E+03	7.486E+03	-3.155E+03	0.	9.759E+03	-54.2
3	3	-8.459E-01	1.006E+04	1.006E+04	-3.016E+03	0.	1.370E+04	-45.0
4	3	-9.623E-01	1.810E+04	1.177E+04	-8.769E-10	0.	1.810E+04	-.0
5	3	-8.459E-01	1.006E+04	1.006E+04	3.016E+03	0.	1.370E+04	45.0
6	3	-6.063E-01	5.382E+03	7.486E+03	3.155E+03	0.	9.759E+03	54.2
7	3	-3.129E-01	2.209E+03	3.766E+03	3.016E+03	0.	6.102E+03	52.2
8	3	-7.350E-17	5.177E-11	1.579E-11	1.480E+03	7.350E+03	1.480E+03	45.0

X	Y	DEFL	X MOMENT	Y MOMENT	X TWISTING MOMENT	SUPPORT REACTION	LARGEST PRINCIPAL MOMENT	BETA X TO LARGEST
0	4	-8.864E-17	2.620E-13	1.051E-12	-2.313E-11	8.864E+03	2.379E-11	-45.5
1	4	-3.451E-01	2.165E+03	4.728E+03	-1.388E-10	0.	4.728E+03	-90.0
2	4	-6.750E-01	5.347E+03	1.028E+04	-5.049E-10	0.	1.028E+04	-90.0
3	4	-9.623E-01	1.177E+04	1.810E+04	-9.252E-10	0.	1.810E+04	-90.0
4	4	-1.134E+00	3.056E+04	3.056E+04	-4.626E-10	0.	3.056E+04	-45.0
5	4	-9.623E-01	1.177E+04	1.810E+04	2.313E-10	0.	1.810E+04	90.0
6	4	-6.750E-01	5.347E+03	1.028E+04	6.708E-10	0.	1.028E+04	90.0
7	4	-3.451E-01	2.165E+03	4.728E+03	7.964E-10	0.	4.728E+03	90.0
8	4	-8.864E-17	2.470E-10	6.273E-11	2.544E-10	8.864E+03	4.254E-10	35.0
0	5	-7.350E-17	9.161E-14	3.672E-13	1.480E+03	7.350E+03	1.480E+03	45.0
1	5	-3.124E-01	2.209E+03	3.766E+03	3.016E+03	0.	6.102E+03	52.2
2	5	-6.063E-01	5.382E+03	7.486E+03	3.155E+03	0.	9.759E+03	54.2
3	5	-8.459E-01	1.068E+04	1.068E+04	3.016E+03	0.	1.370E+04	45.0
4	5	-9.623E-01	1.810E+04	1.177E+04	3.701E-10	0.	1.810E+04	.0
5	5	-8.459E-01	1.068E+04	1.068E+04	-3.016E+03	0.	1.370E+04	-45.0
6	5	-6.063E-01	5.382E+03	7.486E+03	-3.155E+03	0.	9.759E+03	-54.2
7	5	-3.124E-01	2.209E+03	3.766E+03	-3.016E+03	0.	6.102E+03	-52.2
8	5	-7.350E-17	-1.849E-10	-4.589E-11	-1.480E+03	7.350E+03	-1.480E+03	45.0
0	6	-4.779E-17	-6.168E-11	-1.544E-11	2.490E+03	4.779E+03	-2.490E+03	-45.0
1	6	-2.314E-01	1.839E+03	2.297E+03	4.882E+03	0.	6.956E+03	46.3
2	6	-4.433E-01	4.251E+03	4.251E+03	4.449E+03	0.	8.700E+03	45.0
3	6	-6.063E-01	7.486E+03	5.382E+03	3.155E+03	0.	9.759E+03	35.8
4	6	-6.750E-01	1.028E+04	5.347E+03	1.365E-09	0.	1.028E+04	.0
5	6	-6.063E-01	7.486E+03	5.382E+03	-3.155E+03	0.	9.759E+03	-35.8
6	6	-4.433E-01	4.251E+03	4.251E+03	-4.449E+03	0.	8.700E+03	-45.0
7	6	-2.314E-01	1.839E+03	2.297E+03	-4.882E+03	0.	6.956E+03	-46.3
8	6	-4.779E-17	-1.234E-10	-3.086E-11	-2.490E+03	4.779E+03	-2.490E+03	45.0
0	7	-2.275E-17	-6.060E-11	-1.110E-11	3.013E+03	2.275E+03	-3.013E+03	-45.0
1	7	-1.216E-01	1.034E+03	1.034E+03	5.773E+03	0.	6.807E+03	45.0
2	7	-2.314E-01	2.297E+03	1.839E+03	4.882E+03	0.	6.956E+03	43.7
3	7	-3.124E-01	3.766E+03	2.209E+03	3.016E+03	0.	6.102E+03	37.8
4	7	-3.451E-01	4.728E+03	2.165E+03	1.711E-09	0.	4.728E+03	.0
5	7	-3.124E-01	3.766E+03	2.209E+03	-3.016E+03	0.	6.102E+03	-37.8
6	7	-2.314E-01	2.297E+03	1.839E+03	-4.882E+03	0.	6.956E+03	-43.7
7	7	-1.216E-01	1.034E+03	1.034E+03	-5.773E+03	0.	6.807E+03	-45.0
8	7	-2.275E-17	-7.602E-11	-1.495E-11	-3.013E+03	2.275E+03	-3.013E+03	45.0
0	8	1.267E-16	-4.109E-26	-2.414E-25	1.584E+03	-1.267E+04	-1.584E+03	-45.0
1	8	-2.275E-17	-3.037E-11	-1.377E-10	3.013E+03	2.275E+03	-3.013E+03	-45.0
2	8	-4.779E-17	-4.628E-11	-1.850E-10	2.490E+03	4.779E+03	-2.490E+03	-45.0
3	8	-7.350E-17	-3.047E-11	-1.233E-10	1.480E+03	7.350E+03	-1.480E+03	-45.0
4	8	-8.864E-17	-2.979E-11	-1.231E-10	8.905E-10	8.864E+03	-9.682E-10	-46.5
5	8	-7.350E-17	-1.505E-11	-6.159E-11	-1.480E+03	7.350E+03	-1.480E+03	45.0
6	8	-4.779E-17	-2.347E-14	-5.807E-15	-2.490E+03	4.779E+03	-2.490E+03	45.0
7	8	-2.275E-17	1.203E-11	3.192E-11	-3.013E+03	2.275E+03	3.013E+03	-45.0
8	8	1.267E-15	3.424E-26	-6.848E-26	-1.584E+03	-1.267E+04	-1.584E+03	45.0

STATICS CHECK.   SUMMATION OF REACTIONS = 1.000E+05

```
TIME FOR THIS PROBLEM =     0 MINUTES    1.557 SECONDS


ELAPSED     TIME =     0 MINUTES   46.509 SECONDS


PROGRAM  SLAB35E CERL SPECIAL DECK-ARE-JJP,FLE   REVISION DATE 07 SEP 70
     SAMPLE PROBLEMS TO DEMONSTRATE PROGRAM USE        - 24 SEPT 70 - JJP,FLE,JLR
     CONTRACT DACA 23-70-C-0076                           UNITS ARE LBS AND INCHES


ELAPSED     TIME =     0 MINUTES   46.524 SECONDS




***THIS SERIES OF PROBLEMS WAS RUN USING A PROGRAM DEVELOPED FOR THE
   TRANSPORTATION FACILITIES BRANCH,
   DEPARTMENT OF THE ARMY,
   CONSTRUCTION ENGINEERING RESEARCH LABORATORY,
   CHAMPAIGN, ILLINOIS

               BY

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